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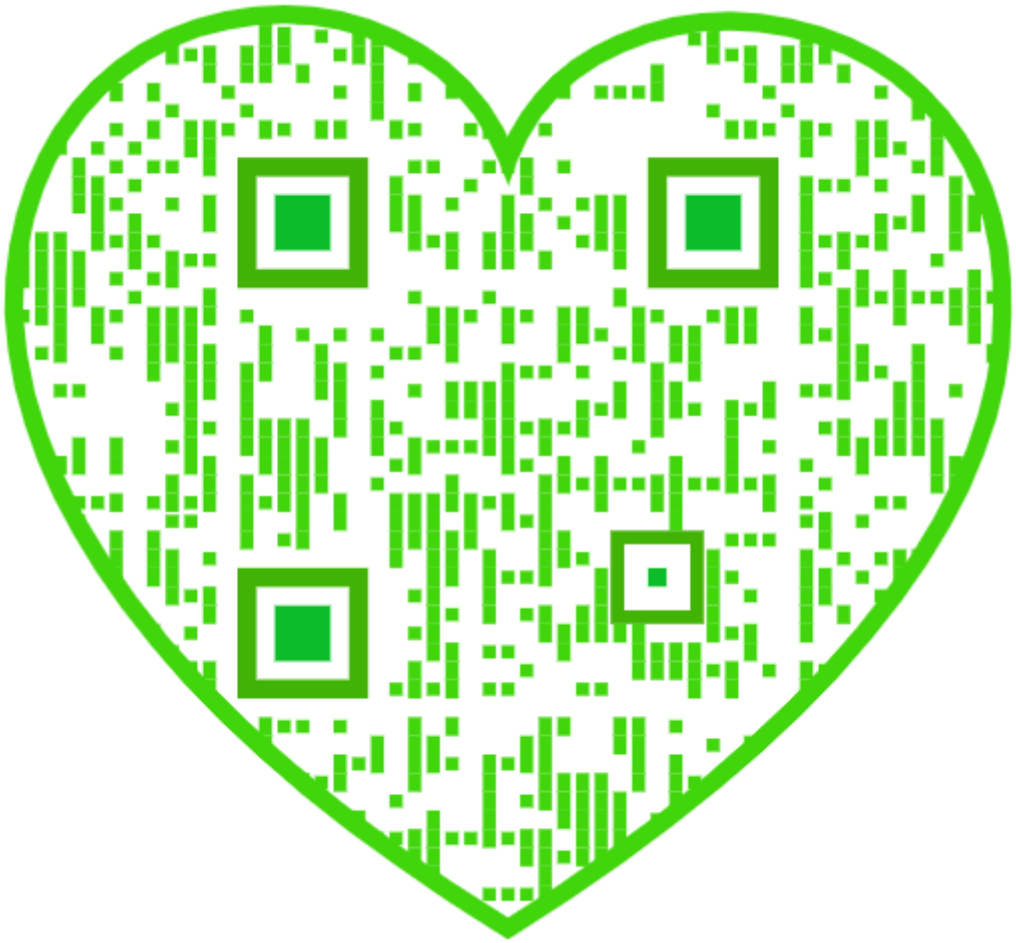

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COMMONWEALTH OF PENNSYLVANIA—DEPARTMENT OF AGRICULTURE.
DIVISION OF FORESTRY.

PRELIMINARY REPORT

OF THE

COMMISSIONER OF FORESTRY

FOR 1896.

ALSO MISCELLANEOUS PAPERS ON FORESTRY CONTAINED IN ANNUAL REPORT, DEPARTMENT OF AGRICULTURE, FOR 1896.

BY J. T. ROTHROCK, M. D.,

COMMISSIONER OF FORESTRY.

CLARENCE M. BUSCH,
STATE PRINTER OF PENNSYLVANIA,
1897.

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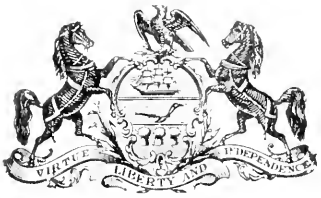
VIRTUE
LIBERTY AND INDEPENDENCE

PRELIMINARY REPORT.

HARRISBURG, PA., January 1, 1897.

HON. THOMAS J. EDGE, Secretary of Agriculture:

SIR: I have the honor to submit the following statement of the work done in the Division of Forestry, and to suggest some measures which appear to be of sufficient importance to merit careful consideration.

The brief paper upon forest fires which appeared in the last annual report was merely preliminary to a more full consideration of the subject. Upon this the division is now engaged, and it is hoped, when all the facts are ready for the public, that it will lead to a more general attempt to discover and bring to justice those who are guilty of starting these fires.

There are, however, certain points upon which immediate legislation should be had. For example, under the Act of June 2, 1870 (P. L., 1316), it is declared to be the duty of the county commissioners to appoint persons, under oath, to ferret out and bring to punishment all persons who wilfully, or otherwise, cause the burning of timber lands and to take measures to have such fires extinguished, where it can be done. The expenses are to be paid out of the county treasury, the unseated land tax to be the first applied to such expenses.

This law has been practically inoperative for more than a quarter of a century. It was not because the law was deemed unnecessary by the citizens, but because, first, there was no clause compelling the county commissioners to appoint detectives to ferret out the offenders; and second, because if they had done so the county would have been required to pay for the services.

The time has come when public opinion demands that the law shall be compulsory upon the county commissioners, and furthermore, it is no longer doubted that the State has as much to gain in preventing forest fires as the counties have, and that, therefore, the Commonwealth should share in the cost as well as in the benefits.

At present, Lehigh is the only county in the State which complies with the law, so far as we are informed. Three or four counties offer rewards for detection of incendiaries, and the remainder appear to wholly ignore the act.

I would, therefore, most respectfully submit for your consideration that the Act of June 2, 1870, be amended: First, to compel the commissioners of the various counties to appoint detectives, as specified already in the act; and second, to place half of the cost of the services upon the State.*

Nothing more inequitable appears upon our statute books than the law as it now stands. The benefits of continuous, even water flow, guarding against freshets on the one hand and low water on the other, accrue to the entire community. The most potent factor in ensuring this desirable condition is the forest cover upon the headwaters of the streams. The counties with the largest areas of timber, or even brush land, are those most active in guarding the water flow of the State, but they also have the smallest population. For the State's good they are, as the law now is, compelled to protect the largest areas, to pay out the most for the common good, while on the one hand they have the smallest income by tax, and on the other they receive the least from the State for the service rendered. The counties with the largest revenues would never feel the drain upon them in protecting their forest areas, while a similar service would keep Pike or Forest counties in a condition of bankruptcy.

It is now well understood that the actual loss to the State each year from forest fires is enormous (greatly exceeding any cost of protection), but the destruction of young timber, of leaf mould and of good soil from the same cause is, if possible, a vastly greater calamity. In short, it is so great that it is no mere figure of speech to say it threatens the continued prosperity of the Commonwealth. In the present state of public information upon this important topic it would seem to be the duty of the State to keep continually before its citizens the fact that forest fires are a public foe. To this end, I would respectfully suggest that constables be required by law to report at each court of quarter sessions the number of fires within their districts, the season at which they occurred, the causes thereof, the damage done, and the measures taken to apprehend those who caused them, the said report to be made in duplicate upon blanks furnished by the Commissioner of Forestry, and that one copy be retained by the court and the other be forwarded promptly by mail to the Commissioner of Forestry, and that the constables be paid jointly by the counties and the Commonwealth for the service.†

In this connection, it might be well to call attention to the fact that in some instances it was found to be impossible to obtain from county officials information, which it was not less for the good of the county than of the Commonwealth, should be published. With

* Act of July 15, 1897, amends act as suggested.
† Act of March 30, 1897, make constables ex-officio fire wardens

your permission, I would suggest that not only would the work of this division be advanced, but that of the whole Department (and possibly of other departments) if there were had some legal relief in this respect.*

By Act of Legislature (June 18, 1883, P. L. 112), the county commissioners, through the assessors, were required to furnish annually, upon the first day of June, "a full statement of all property taxable for county purposes, showing the real and personal in separate columns"—"the same to be enclosed by mail to the Secretary of Internal Affairs."

The returns are made upon blanks furnished by the Department of Internal Affairs, which (blanks) contain separate columns for cleared land and timber land. In the report of the Secretary of Internal Affairs, Part II, for 1895, pages 216a and 217a, is a very clear showing of the insufficiency of this classification of the area of the State for the purposes of that Department. With the best intention and even after laborious effort to report the exact ratio of cleared and timbered land, there might still be wide discrepancies in the statements of two observers, if placed in the same district. For example, take the latest statistics from the county of Wayne, and we find that the proportion of timber land to that of the whole county is placed at 9.2 per cent. Whereas, in the adjoining county of Lackawanna, the proportion of timber land to the entire area of the county is placed at 16 per cent. It must be clear to any observer passing through these counties that Wayne, as a matter of fact, has a larger proportion of its area in real lumber than Lackawanna. The discrepancy here arises from the fact that some of the assessors in Wayne county failed, probably, to consider hard wood, such as beech, birch and maple, as timber, because it had so little value in the market, or was so little used for purposes of construction. The "acid factories" have been unusually active in that region because of the abundance of these woods.

The real fact is that a very large proportion, even of our country citizens, fail to discriminate sufficiently between the different kinds of trees. Of course this lack of exact knowledge is, as a rule, even more marked among those who have spent their entire lives in the towns. This condition of affairs is humiliating, but it has to be reckoned with in all of our reports. Much as this division desires exact specific knowledge, it is thought better to suggest a classification of the wild or wooded lands not under cultivation, which will now lead to the least error and encourage the hope that in the near future we may be able to insist upon a more exact classification.

I would suggest, first, that for the purposes of the Department of

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* Act approved April 14, 1897, makes it the duty of county officials to furnish information asked for.

Agriculture, land which is now in sod, or in crops, or which has been cultivated within three years, or which is about to be cultivated for the first time, be regarded as cleared land.

Second. That land not in either of the above conditions, but covered with a growth of shrubbery less than 15 feet high, be designated as brush land, and this be divided into two classes; i. e., valuable, if it promises to mature into timber; or, valueless, if it gives no promise of producing timber.

Third. That land in a woody growth which is over 15 feet high, be designated as timber land, and divided (a) into evergreen, stating whether pine (white or yellow), hemlock, spruce or cedar predominates; and (b) into hard wood, stating whether oak, hickory, chestnut, beech, birch, maple, poplar, basswood or cherry predominates; adding whether this timber is best adapted to production of ties, sawed timber, or of no use except as fuel. Is the timber in this third division one-fourth, one-half, or three-fourths grown, or is it mature?

There appears to be nothing in this which a man of ordinary intelligence could not readily place in proper form if a proper blank were furnished him. It is confessedly superficial, but it is far in advance of what we have hitherto been able to obtain.

It is fairly a question whether or not it is wise to allow the redemption within two years of land sold for taxes. As a rule, those to whom such land belongs are not straightened in circumstances. The redemption clause simply, in many instances, interferes with improvement of the forest conditions of such land which can be undertaken none too soon. Furthermore, if that redemption clause were repealed, it is more than likely that, very often, if not in most cases, the tax would be paid, rather than allow the land to go to sale. The county, at least, would then receive benefits from the change.

The whole question of taxes in relation to timber lands is as important as it is anomalous. It may be briefly stated at the outset that the only class of property which existing law compels an owner to destroy in self-protection is timber. There are thousands of acres within the limits of this Commonwealth which might have been (in the interest of the State) in timber to this day, if uncertain protection against fire and certain demands for taxes had not driven the owners to remove the timber. If it is true, as asserted, and as the experience of those nations with which we must compare ourselves seems to show, that a state must in its own interest have a certain (variable) proportion of its area in timber, or suffer in lack of it, then our laws defeat their own purpose by driving the citizen to despoil rather than to strengthen the State. An illustration may be worth more than any abstract statement, however clear or pointed.

In one of the interior counties of the State there was situated

a tract of land covered with valuable hemlock. For the purposes of taxation this land was assessed at the rate of two dollars an acre, then raised to four, then to six, when the owner protested. The following year it was assessed at eight dollars an acre. Protest made was unavailing and the owner immediately put in mills, removed the timber and allowed the county to take the land.

The plea for increasing the tax was that the township depended on that land for the money to spend on its roads. What was the result? Removal of the timber left no tax for the roads, and gave the county a large area of unproductive land. It was not solely the payment of the taxes which drove the owner to remove the timber, but because after paying the taxes he had no protection against the fires which the State allows to go, year after year, unchecked. Here is the proper place to call attention to the fact that it is no longer true that fire does but little damage in green timber. The time was when it was practically true. That time has passed, for in this State so large a portion is already bare of trees, barren and sun-exposed, that evaporation removes the moisture from those areas, and then from even the woods, until in seasons of ordinary summer drought vigorous forests may be killed where they stand. One instance of this, in Clearfield county, comes to mind now. Another example was furnished three years ago in the southwestern part of Wayne county, where a very valuable tract of hemlock, which was specially guarded, was destroyed in spite of all the protection which could be furnished. A condition so anomalous as this indicated cannot endure in the larger intelligence of the near future. What the remedy shall be is a question which merits, and doubtless will receive, careful consideration from our legislators before long. It will press for a solution.*

A most important problem presents itself for consideration, namely, that of forest reservations. Strip it of collateral ideas and the fact at the bottom of the whole question is—the State must have a due proportion of woodland. It is an absolute condition upon which not only our prosperity but the very protection of the surface of the State depends.

The first inquiry following this is: How can it be most surely, speedily and economically produced, by the State itself directly owning and directing the machinery, or by the State making it possible for the citizen to do this?

While it is true that in Pennsylvania local conditions will make it to the advantage of the Commonwealth that the citizen should become a timber producer and himself see that it was guarded from

* By act approved May 25, 1895, there is allowed a maximum tax rebate of forty-five cents per acre on not more than fifty acres to each farm property owner, providing there are fifty trees to the acre which average eight inches in diameter at six feet above the ground

trespass and from fire, it is nevertheless true that the State should be the largest producer, because it has the largest interest, because the century required to mature a crop of trees is as nothing to it, but is disheartening to the individual, and chiefly because in the land which the State should own there are involved possibilities for good or evil, to every citizen, which are too vital to be trusted to any man or to any set of men.

The idea is not new to our people. It may be well to note how far it has progressed and assumed the favor of a popular demand.

1st. The State Grange of Pennsylvania, in the last two annual meetings, passed resolutions calling upon the Legislature to provide State forestry reservations.

2d. The Maritime Exchange, of Philadelphia, has petitioned the Legislature for State forestry reservations.

3d. The Board of Trade, of Philadelphia, has done the same.

4th. The Pennsylvania Forestry Association, with a membership in every county in the Commonwealth, has joined in the request.

5th. The Engineer Club, of Philadelphia, has also asked for it.

6th. Almost every leading newspaper in the Commonwealth has repeatedly, editorially and otherwise, joined in the general call for State forestry reservations.

7th. Various leading industrial journals, such as the "Manufacturer," have been outspoken in their demand that in their interest and protection the State assume control of the high water sheds of the Commonwealth, where the water power which they require is produced.

It will be seen that already a most respectable following is earnestly asking the State to act in this direction.

If it were new or untried in this country, we might well pause before taking the initiative; but it is neither. The adjacent State of New York has been the pioneer in this movement, and secured as public property already a large portion of the Adirondack region. The wisdom of the action was voted upon three years by the people, and of all the constitutional amendments brought before that tribunal for their sanction, the one measure which passed unchallenged was that in favor of the State forestry reservations. Within a month the question was again placed before the people as to whether the State should allow settlements by cottagers of any part of the forest reserve, and so anxious were the citizens to confirm forever the safety of these reservations that they defeated the constitutional amendment, which made an invasion possible, by the largest majority (345,000) ever given to any measure, State or National, in New York. It was most remarkable that on this issue the average citizen and the largest manufacturing interests were in perfect, earnest, working harmony. Almost every great newspaper

in the State called and kept calling upon the citizens to defeat the proposed constitutional amendment. The threatened danger produced the most universal popular rising and protest which the Empire State ever witnessed.

There must be some reason for this. Such things do not come about by chance. It would be almost impossible to have produced such an overwhelming sentiment by any party machinery.

The fact is that the cause of alarm sounded in New Hampshire by the Hon. T. Jefferson Coolidge, was already working in New York. It is worth dwelling upon.

I have been at the pains of verifying the following abstract which is taken from the "Manufacturer," Philadelphia, October 31st, 1896. As I can neither condense nor improve upon the presentation, I submit it for your consideration:

FORESTS AND FACTORIES.

"In his annual report to the Amoskeag Manufacturing Company, whose great mills are located at Manchester, New Hampshire, utilizing, as those below at Nashua and Lowell do, the splendid water power of the Merrimack river, the treasurer of the company, Hon. T. Jefferson Coolidge, of Boston, stated some important facts concerning the usefulness of the river for manufacturing purposes. He describes first, the great freshet in the Merrimack, on April 16, 1895, when the water rose to the highest point that until then had ever been known, injuring the Amoskeag dam, and compelling extensive and costly repairs. He then describes the terrific freshet of March 2, 1896, which rose 1½ feet higher than even that of the preceding year, and which compelled the stoppage of the mills, with their 6,000 operatives, for some time, and would have done immense damage to the mills, had it not been for the strong repair construction of the previous year.

"'I need not say,' proceeds Mr. Coolidge, 'what a terrible loss to the city of Manchester such accidents are, and how desirable it is to take any measures which may diminish the probability of future and higher freshets. When you consider that the Merrimack has for the past few summers been lower than in previous years, it is evident that some cause is at work turning the stream into a torrent with long droughts and fearful discharges of water.'

"There is but one explanation, he further says of this phenomenon. It is simply, 'the cutting down of the forests around the headwaters of the Merrimack, the Pemigewasset and other affluents. The woods hold back the water and allow it to trickle slowly into the streams;

cut down the woods and the rain running rapidly over the surface of the ground, which is baked by the sun or frozen hard by the winter's cold, pours all at once into the streams, turns them into roaring torrents, and finds its way all at once into the Merrimack, sweeping everything before it. In a few days the river sinks rapidly and becomes in time of drought an insignificant stream. Had the forest been left, no sudden discharge of water would have taken place, and all through low water, streams would have trickled through the woods and swollen the Merrimack when it was low.'

"Remarking upon the experience of European countries in this matter, especially France, along the valley of the Rhone, by which they were compelled to adopt stringent measures to protect the forests along the rivers and their affluents, Mr. Coolidge proceeds to point out the great seriousness of the subject to such a city as Manchester, and such a state as New Hampshire. It is the power of her rivers which gives New Hampshire its greatest importance. The damage done, he declares, is already most serious, 'and if this state of things continues, manufacturing by the water power of the Merrimack will become, in my judgment, impossible. No new mills will be put up and the old ones will have to use steam, which places them at a great disadvantage with regard to other manufacturing cities where coal is much cheaper owing to less transportation. Our coal has to be carried to the seaboard at Baltimore or Newport News, transported by water to Portsmouth at a cost ranging from sixty cents to $2 a ton, and taken by car to Manchester at an additional price of twenty-five cents for unloading and seventy-five cents for freight from Portsmouth to Manchester.'

"The strength of such manufactories as the Amoskeag Mills consists largely in their situation where nature pours over their waterwheels, at the lowest possible cost, the power that moves their spindles and looms. If these water powers are to be destroyed, such industries will be practically destroyed. If steam must be used, and coal brought from the distant mines, the condition will be revolutionized. Compared with Falls River, Manchester is at a disadvantage of $1 a ton in the purchase of coal, and compared with mills in the South, $2 a ton. 'I appeal to you, gentlemen,' earnestly says Mr. Coolidge, 'for the interest of New Hampshire, which depends on the success of the manufacturing corporations situated on the Merrimack and the other streams of the State, to exert your utmost influence to induce the next Legislature to protect the forests remaining.'"

You will recognize that this most vital relation of the forests to the water powers of the State is not new here. It was most fully brought out by the Commissioner of Forestry and enforced by photographic illustrations at the meeting of the State Board of Agricul-

ture, held in Bethlehem in June, 1893. What gives, however, special weight to it now is the fact that the statement above quoted is from a practical man, with large business interests, and is his well weighed, deliberate utterance, after the threatened danger had developed into an accomplished fact. Surely, it may be regarded as beyond the dictation of mere sentiment, and as a timely and needed warning to us. If the condition of things which Mr. Coolidge depicts as existing in New Hampshire calls for State interference there to protect the manufacturing interests, a similar condition here equally demands that our State shall interfere to arrest the calamities which have already threatened to wreck and injure the prosperity of another State.

It may be taken for granted that in the near future Pennsylvania will follow the example already set by the State of New York.

The question remaining is, how shall the land be acquired? It is in vain to hope that the Commonwealth will come into possession of any area worthy to be called a state forestry reservation upon which a mature forest now stands, for such no longer exists within our limits. Every such body of timber is reduced in size, and circumscribed by clearings. The very utmost that we can do will be to secure the location and to produce the forest. We will be wise if we obtain the place before we are obliged to produce the soil as well as the trees. Even now it is probable that it will cost the Commonwealth as much to obtain the naked, treeless area as it received for the same ground when it was covered with timber, out of which fortunes have grown. It is quite clear that as the necessity of these lands to the State become more and more real, they will be held higher by the owners, even though each succeeding year has rendered the soil more and more impoverished. Neither will there ever be a time when the demand made upon the State Treasury will be so light as to render the acquisition of the needed land easier than now if they are to be acquired by exercise of the right of eminent domain and subsequently paid for.

The state of New York acquired most of its present reservation in the Adirondack (I believe), by sale for unpaid taxes.

This raises the question as to whether Pennsylvania might not do the same. It is within bounds to say that there is a million of acres within our limits upon which the owners now refuse to pay taxes. Or to speak exactly, we may put it thus, that "in 1894, the amount of land, seated and unseated, advertised to be sold for taxes in the different counties of the Commonwealth, so far as heard from, was upwards of 1,500,000, or 2,358 square miles." These figures come from lists furnished by county treasurers. This land lies in great part within the limits which the Forestry Commission has suggested as being suitable for State forestry purposes. One may

then readily see that if the State were to acquire title to all such lands, but few years would elapse before either taxes would be paid to the counties, or the State would be in possession of all the land required for its forestry purposes. The chief objection to land so acquired would be: It would at first be more or less scattered and therefore relatively costly to protect and manage.

It is no longer a problem as to whether forest lands, under proper State management, can, or should be, made a source of revenue to the government. The magnificent results attending the forestry operations of Germany, Sweden and Norway, and England in India, leave no doubt that no other line of public policy returns a surer or larger revenue, involving at the same time less injury to the individual or less loss to the government. That it can be made to pay here we may infer from the prices which are offered to New York for spruce grown under state protection.*

There remains yet one more aspect of this many sided question. Communal forests are managed in Germany in local interests. To adapt this statement to our own conditions it would appear as though a county having a considerable area of land thrown upon it by non-payment of taxes, might under judicious care and protection, in a comparatively few years, obtain a very large portion of its needed revenue from sale of wood from such land. The whole success of such an attempt would lie in honest, intelligent management; but it would relieve the citizens of the burdens of taxation just in proportion as it was successful.

There are towns in Germany which have made themselves practically free from taxation by the sale of forest products. The fact is an unfortunate commentary on the methods we have employed to reach our present condition, as a State and as a Nation, that though there will never come a time when our best kinds of timber will cease to have a value, that the true Northern yellow pine (Pinus mitis) has practically disappeared from our forests, and there is reason to fear that in the very near future yellow poplar, black walnut and wild black cherry, hemlock and white pine will cease to have large commercial value here, because of scarcity.

The report of the Forestry Commission has been so kindly received and is in such demand that the edition will probably be speedily exhausted.

The Commissioner of Forestry proposes to prepare the following papers as speedily as possible:

First. Report on Forest Fires.

*Since the above was written the Legislature has passed, and the Governor has approved, two acts providing for State Forestry Reservations—one by purchase of a reservation of not less than 40,000 acres at the head waters of each of our three principal rivers (act of May 25, 1897); the other by the State paying the taxes on land sold at treasurers' and commissioners' sales for taxes (act of March 30, 1897.)

Second. Report on Walnut Tree, producing fruit with the outer covering of the hickory nut.

Third. Report on the Engle Chestnut Orchard.

Fourth. Report on Some Troublesome Weeds.

Fifth. Abstract from Recent German Forestry Reports.

Sixth. The "Yearly Cut" of Timber in Pennsylvania.

Seventh. Forests as Soil Formers and Soil Preservers.

I am sir, with respect,

Your most obedient servant,

J. T. ROTHROCK,

Commissioner of Forestry.

COMMONWEALTH OF PENNSYLVANIA—DEPARTMENT OF AGRICULTURE.
DIVISION OF FORESTRY.

MISCELLANEOUS PAPERS

ON

FORESTRY,

FROM

ANNUAL REPORT,

DEPARTMENT OF AGRICULTURE

FOR 1896

BY J. T. ROTHROCK, M. D.,
COMMISSIONER OF FORESTRY.

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RELATION OF FORESTS TO THE FARMER.

Nothing stands absolutely alone in itself and by itself. Every created thing has its relations to other things and forces. Indeed, the whole orderly procession of nature is the result of forces which have become mutually associated and inter-dependent. It sometimes happens that the most obvious purposes are in reality the least important. The forests furnish a striking example of this. If asked to name their uses the first answer would almost certainly be: for lumber and fuel. Yet in the eternal scheme these are the very least of all the important purposes they subserve, and the results of these uses are probably the least enduring of all which spring from the forests. To obtain these utilities the trees, as a living body, must be sacrificed. They cease to operate as a portion of any natural plan the very moment they become either lumber or fuel. Not only so, but in serving either of these purposes they compete with substances which, to a greater or less extent, could be substituted for them. In such functions trees are in strong contrast with themselves, when we remember that as living things their uses are unique, and that nothing which they do for the rest of creation could be so well done by anything else.

Without thought, we regard the earth as having been always timber-clad, until human energy opened the clearings in which crops were to be produced. Such, however, is not the fact. All science is in accord with the belief that forest trees, as we now know them, are the end of a long line of plant life. When extensive areas emerged from the waves to become dry land, and at length the abode of human beings, nothing of higher form than a rock moss or a lichen was there to represent the vegetable kingdom. Indeed we are driven to this conclusion by many arguments, and by none more forcibly than by the fact that soil capable of supporting a large-sized tree did not exist. There was no soft substance into which the roots could penetrate to fix the trunk in an erect position, or from which it could draw the needed nourishment, which the air failed to supply. Our large trees won their hold upon the earth only after lichens, mosses and ferns and palms had preceded and prepared the way for them. Even then there remained ages upon ages during which we should have recognized among the stately forms none of the familiar trees of our own time. Whatever possibilities of lumber or fuel were in the stick were to remain until the earth, largely through the agency

of trees, became fitted for its final occupant—man. Then, and then only, almost as an afterthought, the possibilities of lumber and fuel appeared.

The object of this preliminary statement is not in any sense to undervalue the importance of either lumber or fuel, for they are most important portions of the foundation upon which human prosperity has been built, but to emphasize the fact that forests had a history of development before there was a man upon earth, and that they have been largely instrumental in preparing it for his home.

In further discussing this subject it will be convenient to consider:

First—How forests came.

Second—What they have done in the past.

Third—What they may and should do in the future.

Fourth—Can they be spared?

1. How Forests Came.—Any conception of the early history of our globe involves ideas which are strange to some persons and incredible to others. Briefly stated, however, the earth is regarded as a ball which has cooled down from a molten or semi-molten condition, and that in its interior there still remains a core of fire. Such we assume to have been in part the history of the other bodies floating around us in space. The process of solidification and cooling was not only a gradual, but a very slow one. The first plant life was probably in the water which collected in the depressions on the earth's surface. Later those gray, scale-like masses, which we call lichens, or rock moss, appeared on the dry surface of the rock. The reproductive bodies of these lichens are microscopic in size and of the simplest character, so far as a structure is concerned. Cast loosely upon the rock, any blast of wind might carry them away. Indeed, many of them are thus transplanted. But they have the power to dissolve the substance of the rock, form a minute nest for themselves, such as befits their size, and then to produce threads, by growth, which eventually unite with small green bodies, likewise of microscopic size, and form a living crust on the surface of the rock. The growth of such a lichen is exceedingly slow; and, therefore, its life is correspondingly long. When, however, it does die, there is left behind a thin stratum—the beginning of a soil—the nest in which another lichen may begin an easier life, or where, possibly, some plant of higher organization may appear. It is not to be supposed that there was no other force at work in forming the first soil. The weight of a falling raindrop may loosen a stony particle. Snow, when it at length could remain on the earth's surface; ice and frost each did their share in rending the rocks, and in proportion as these solid masses became smaller, the work of soil production became easier and more rapid, because an increasingly greater surface was ex-

posed to the action of these disintegrating forces. Mosses in all probability came later, grew along with the lichens, and dying, added their remains to increase the bulk of that union of broken down rock and vegetable matter which we call soil. Ferns and club mosses, both of goodly size, sprang up where the lichen and the moss had prepared the way. Palms succeeded these, and after a long interval the familiar trees of our own forest appeared upon the scene.

Such, in brief, are the stages leading up to the forests which we assume the right to destroy at will, as if blotting them from the surface of a country could be effected without doing a most serious injury to an order of events which had required vast periods of time to mutually adjust.

2. What Have Forests Done in the Past?—By this we mean before man appeared upon the earth, and apparently in anticipation of his coming. The assertion has been made that a probable cause of the disappearance of the luxuriant vegetation of the coal-forming period was that the plants themselves had extracted so much of the carbonic acid gas, or carbon dioxide, from the atmosphere that their successors were no longer able to live. If that be so, then we may be well assured that they were making the air, by so far, more fit for animal life. The question, however, here is not as to the fact, but as to the extent of its operation. There is not only no doubt whatever that all plant life does make an atmosphere better fitted for us, but that it is the most active known agent in maintaining that salubrity. Most other things, living or dead, tend to abstract oxygen from, and many, in addition, pour out carbon dioxide into the atmosphere. In fact, so long as plant life is vigorous, active and engaged in increasing the sum total of vegetable substance, just so long plants, and our long-lived trees especially, are enriching the atmosphere for our uses. It is only when they are flowering, fruiting or decaying that this statement is reversed and a surplus of carbon dioxide given off. Just here the special value of the trees becomes strikingly apparent. In them decay is usually long postponed. The flowers are but a small proportion of the surface of the tree, and the maturing fruit is even less. The preponderance of the healthful agency over the noxious becomes at once clear in this light.

Hills and valleys are produced in two ways. By the one process, as the crust of the earth cooled it contracted on the central core. The diameter of the earth is decreasing with each successive age, just in proportion as the loss of internal heat allows it to contract. The outer crust (upon which we live) wrinkles, as it contracts, as an apple does, when, from evaporation, it parts with the moisture contained under the skin. These wrinkles on the earth's surface, which appear so vast to us, are the mountains and the valleys. Taken,

however, in the measure of the earth's diameter, they are ridiculously small. If you had a globe eleven and one-half feet in diameter, a raised line one-sixteenth of an inch high upon it would about represent the height of our mountains to the diameter of the globe, and the one-thousandth of the thickness of that tiny line (equal to one-sixteen thousandth of an inch) would approximately represent the depth of the surface which we know as soil, and with which we, as food producers for the rest of the earth's population, have to do.

If these folds, or ridges and mountains, did not exist, the earth's surface would be a monotonous plain, practically everywhere equally distant from the centre of the earth, except in so far as that distance was modified by the differences between the polar and the equatorial diameters of the earth. Our streams would flow slowly—in the Northern hemisphere toward the northeast, and in the Southern hemisphere toward the southeast, and the large masses of water would gravitate to the poles, as those would be the portions of the earth least remote from the earth's centre. The continental land masses would tend to be in the equatorial diameter of the globe because the land there would be the highest, i. e., most distant from the earth's centre.

The introduction, however, of these shrinkage folds, which we now recognize as mountains, completely changes these relations. Water will flow downward along the lines of least resistance, and as it flows will wear away the soil first and the rock next, in exact proportion, other things being equal, to the rapidity of its flow. We see this in the washes on our hillsides and in the constantly changing courses of our stream channels. But other things are not equal. If they were, the tendency to the formation of ravines and gulches, by erosion, would not exist, and everywhere over an equal slope the wearing away of the soil would proceed evenly, and the unbroken character of the country would in great measure be preserved, or more properly speaking, the tendency to an even reduction of our mountains would everywhere exist.

As it is, vast discrepancies in the character of soils and rocks occur; some yielding to erosion by flowing water more easily than others—and it is along such lines of least resistance that currents of equal velocity carve out their valley channels to [illegible], following, of course in most instances the trend of the larger valleys made by the folds in the earth's crust.

The one factor which is potent in giving character to the earth's surface and which we can largely control is the rapidity of the water flow. Under natural conditions, [illegible] country, the normal tendency of [illegible] would be [illegible] rapidity of flow [illegible] of [illegible] afforded, [illegible] and indicated by the

trees. This fact has been well put by Professor Shaler.* "In a single day a tilled field may lose from its surface more soil than would be taken from it in a century of its forest state."

The above opinion is unquestionably true. The principle is, to put it in the words of Major Raymond, of the United States Engineer Corps, "as well established as any other in physical science." Since then it is so important, it is worth a consideration in detail. Briefly the proposition may be thus stated:

Forests by retarding the rapidity of the water flow tend, in so far, to prevent the washing away of the surface soil, which is one of the most important elements in agricultural prosperity.

The expression, "pelting of the storm," is no mere figure of speech. Those who have felt the weight of a falling rain-drop in an open country will readily recognize that it brings with it a positively appreciable force. If careful observation is made where the drop falls on the earth, it will be noted that it has loosened the soil and made a miniature excavation. The water of the fallen drop immediately dissolves (at least in part) this loosened soil and begins its journey downward. Careful observation will also show that in an ordinary uncovered space, each drop does an appreciable work—if the soil is at all soft. The aggregate of the fallen drops produces the inundation. The aggregate of the soil so removed produces the muddiness of the stream, whether that be very marked, or the contrary. In other words, the muddiness of the flowing water is the measure of valuable, soluble soil removed from the country. It is mostly soil in condition to be used in one way or another by those growing plants which we denominate crops and in whose abundance we find the reward of our labor.† If that soluble portion of the surface of the earth were infinite, or more exactly, if the most fertile part of it, which the plants most need, were inexhaustible, we could contemplate its removal from our fields calmly. But instead of being abundant, there are but few places on the earth's surface where there is enough of it to enable the farmer for any considerable period to pursue his calling without impoverishing his land, unless he takes active, costly measures to restore it. The farmer does not create that fertility. Whether it comes to him through the medium of his barnyard, or by purchase as an artificial fertilizer, he is simply using over and again the old elements which he has transported back to his tilled acres. Hence the wisdom, the actual imperative necessity of holding on to that fertility by all possible methods. This, however, is not all. The increased rapidity with which water drains out of a treeless country is a prolific cause of disaster, not only to those parts

*Aspects of the Earth, p. 275.

†The word soluble here is used not in its chemical sense; but in the sense commonly accepted—i. e., the particles of soil are held suspended in the water.

whence the flood came, but to those into which it flows. Every small stream furnishes an example of this. The severe dashes of rain which were so common during the past summer in countless instances over the State, visibly, palpably, before our eyes, washed the finest, best soil from our fields, where it was needed, into the public roads where it lay first as mud and then as dust, to the detriment of travel. The ordinary brook, unless it be so narrow that every shower flushes and scours it out completely, will show that the sediment from higher up has clogged its course, and what has taken place in this small way is repeated on a grander scale after the tributaries have become confluent into a main channel. The delta of the Nile, and in our own country, the delta of the Mississippi, alike are made up of soil which has followed the course of the river from a greater or less distance to its final destination—the tide water; and silt and soil of the same quality which clogs the channels of the streams above the tide water is mostly fertility on its way to the tide level. Let me again quote from Shaler, l. c. p. 275: "Brief as has been our use of the American land, a perceptible portion of it, probably as much as one-hundredth part of the tillable area, has been reduced to a state of destitution which it will require ages to repair—which indeed is scarcely reparable by the hand of man."

Not only are these facts well known and proven, but the laws governing the rate of water flow requisite to transport material of different sizes can be clearly stated. Thus, in the upper part of the stream bed where the water flows as a torrent, massive rocks may be driven before the flood. Lower down as the current slackens its pace the rocks will have been left behind and simply pebbles will be found; and still lower, where the water flow has been reduced in speed to that of an average river, the wash will be simply sand and soil. The figures startle us, but no less authority than Dana has quoted from Humphrey's and Abbott's report the statement that in an average year the Mississippi carries to the Mexican Gulf an amount of silt equal to 812,500,000,000 pounds. This would cover 241 square miles evenly one foot deep. Geikie (Great Ice Age, page 315) states it thus: "Then again we have to bear in mind that the whole surface of the country is being subjected to the abrading action of running water. Under the influences of rain, soil is continually traveling down from higher to lower levels; rills and brooklets are gouging out deep trenches in the sub-soils and soil rocks; streams and rivers are constantly wearing away their banks and transporting sediment to the sea. The gravel and sand and silt that pave the numerous water courses are but the wreck and ruin of the land."

It is then, under this view of the case, most important for us to bear in mind that of all the substances essential to successful, continuous cultivation of the earth, the one thing most difficult to restore

is this soil, and that the one agency most active in reproducing it, and most valuable in restraining its waste, is the forest cover to the land.

If this were the only function of the forests it would be ample reason for throwing around them every protective care which was not inconsistent with their legitimate uses for lumber and for fuel. It is, however, but a part of what they accomplish. Not only do they mechanically restrain the destructive force of the surface water, but by that very act they give it a better chance to soak into and saturate the adjacent earth. The downward pointing roots furthermore serve as lines along which, with increased facility, the water penetrates to the depths beneath, where it is safe from immediate evaporation, and where it continues (possibly for months) to nourish the smaller streams and to maintain the perpetual flow of our springs. It is further to be observed that this water so saved is in immediate proximity to the smallest rootlets, and is by them absorbed, taken up through trunk and branches to the leaves, where it is evaporated or transpired into the open air. In this flow upward from the earth it not only carries the nutrient matters of the soil, to form the fabric of the tree, but it returns in the form of vapor, to moderate the temperature, a quantity of moisture which might well seem fabulous. Thus it has been estimated by Dr. Evermayer that a beech tree "fifty to sixty years old would transpire about twenty-two pounds of water daily." Multiply this by four or five hundred trees and that by the number of growing days in the year and the immense volume of water which an acre of forest land may furnish through the leaves of the trees is at once apparent. Such an acre would restore to the atmosphere during the six months, from April 1st to the last days of September, about one thousand tons of water by evaporation and transpiration from the leaves, and in the same basis a square mile would furnish 640,000 tons of water, or reduce the number of trees one half, and each square mile during the growing season would return, to the air, over 300,000 tons of water.

It has never been shown that this tremendous volume of water, filtered out from the earth to the clouds, through the trees, actually increases rainfall over the region. But it does bring the atmosphere there, by so much, nearer the point of saturation with moisture, and just so much less water from other sources is needed to load the air with moisture enough to cause a downpour of rain.

There is, however, a relation of the utmost importance to the humidity of the country, in which forests play a large part. It is in preventing, directly and indirectly, the rapid evaporation of moisture from not only the surface which they cover, but from even the surface of the streams themselves, as well as from the areas under actual cultivation. Every pound of water restored by the trees to

the atmosphere is a check upon that dry condition which results in parched earth, and the general dry condition which we have so expressively denominated "drought."

But even here the end of the forest usefulness has not been reached. Coming from above downward, the heat from the sun penetrates our atmosphere readily, and during the day accumulates in the earth more rapidly than it escapes. This constitutes a safeguard which the farmer seldom has fully appreciated. Allow this heat to escape and the surface of the earth to become reduced to, or even near to the temperature of surrounding space, and it would mean destruction of most of our crops. It is the heat of the sun which is stored in our earth that prevents this reduction in temperature, and it is the moisture in the air which holds this life-preserving heat for our benefit. In this respect the value of the forests as producers of watery vapor is simply incalculable.

The network of roots descending from tree, shrub or herb, renders the earth more porous, and to a certain extent produces a sieve-like condition, by means of which the water percolates to the depths below.

We have not yet alluded to the mere mechanical action of the dead leaves in retaining moisture as they strew the forest floor. A very simple experiment will make all this quite plain. Take a basket of leaves in the autumn, just as they have fallen from the trees, weigh them and note the weight. Now place that same basket, with the same contents, out where the snow of winter may fall upon it and melt, as the spring advances. Then weigh it. You will be surprised at the increase of weight. Yet it is caused solely by the water which the leaves have retained. Now, instead of limiting this experiment to a surface of a foot or two, imagine the effect of such a collection of leaves extending over miles of forest floor, and the vast importance of even the dead leaves appears. Every pound of that water, too, is acting as a protection against the dry condition of the atmosphere which prevails during a drought. The leaves, however, have not only been gathering moisture themselves, but they have first aided in the safe storing of the surplus water beneath the earth's surface, and then they have been the most efficient agent in preventing the loss of that water by a rapid and premature evaporation. Furthermore, as these same leaves decayed they have furnished carbon dioxide gas to the water, as it trickled down into the earth, and to a very marked degree aided thus in the dissolving of certain kinds of rocks into the condition of soil.

This vista of the usefulness of the forest to the farmer is endless. It is endless simply because the order of things existing in nature is the result of forces operating through almost endless years, until each has become adapted to the other. The touch of the human

hand when it removes the forest covering, to a certain extent, disarranges this established order. It is unavoidable, nay, it is necessary for human well-being that this should be disarranged; but to effect the change in a hasty, destructive manner, without regard to the operation of any natural law, is but to invoke here the disaster which has already overtaken other nations. On page 261, of "Aspects of the Earth," Professor Shaler has in his usual clear style portrayed some of the consequences: "The most serious misfortune connected with the reckless destruction of the forest arises from the loss of the soil from large areas of land, by which regions naturally fertile have been converted into deserts of irredeemable sterility. Already a large part of many fertile regions has been sterilized in this fashion, and each year a larger portion of this infinitely precious heritage of life slips into the rivers and finds its way to the sea because we have deprived it of the protecting coating of vegetation."

We may now briefly consider what the forests may and should do for us in the future.

First of all, the forests should continue to do for us in the future all that they have done in the past—that is, in so far as their decreased areas will allow that to be possible; but they should do more than this still. They should be made the active agent in restoration of fertility to acres that have already become so unproductive that they will no longer compensate the farmer for his labor upon them.

Mankind, and especially we of this Western world, are still young in our relation to natural laws and but half awake to the impending results of violations of those laws. It is true that in some of the earlier seats of civilized power, deserts have taken the place of fertile fields, and that want exists in the very regions which once were the granaries of great nations. The connection between cause and effect is plain enough when attention is called to it. It is hard, however, to induce the individual to make a personal application of even the plainest lessons. We have not yet reached the point as a people of recognizing that we are responsible for the prosperity of those whom we have begotten, or that at least we have no moral right to leave the world in a worse condition for the support of our children than we found it for ourselves. We have, in full justice, but the usufruct of the lands to which we hold the titles.

This all applies, with full force, to the manner to which we impoverish our hill lands by slovenly farming and then abandon them to the descending rains and melting snows, until they have passed first into an unproductive condition and then into that of a desert.

If there is any one statement which, among the farmers is more common than another, it is that "farming don't pay." Of course upon even that point opinions may differ, and much may depend

upon how the farming is done. It is quite clear that farming cannot continue to pay upon land which is constantly becoming poorer. There must, under such circumstances, come a time when it will cease to be remunerative and then perforce must be abandoned. It is absolutely true that at this very hour a very considerable portion of our State has already reached this deplorable condition. In the nature of the case we cannot say just what the proportion is, but it would probably be safe to say that at least one-tenth of our cleared area has ceased to be remunerative under any ordinary system of agriculture. Furthermore, almost every acre of this land is becoming worse. This condition has become a pressing practical problem, which rises beyond the domain of politics, and into that of statesmanship. Whatever else may be doubtful, it is absolutely certain that no state can continue to be prosperous if its population is increasing and its resources decreasing. The only promise such a condition makes for the future, is want, increased severity in the struggle for food, and political unrest. The only effective measures of relief must be based upon a restoration of those unproductive acres to a productive condition. We are limited, too, in the direction that these measures take, for they must involve a minimum of expense with a maximum of good results.

Thus far we know of but one method by which this can be done. It is to restore all such land to a timbered condition. This proposition is radical, possibly ahead of the times, but it is true nevertheless, and in the experience of men will appear more and more true each succeeding year. It is therefore the height of folly to ignore it.

The one practical question is, how can a change be brought about? This involves two ideas. First, What can the individual farmer do? Second, What should the State do? In what follows it is to be understood that we now speak solely of land which has been farmed and become impoverished, or which has for years at least, been considered part of a farm holding, even though it has never been cleared. We do not refer at present to those larger areas from which the lumber has been removed and which have been abandoned, without care, to the yearly forest fire. Such lands demand a separate consideration.

First, what can the individual farmer do? If he derives no revenue from any lands for his labor he can, at least, wisely suspend unpromising labor upon them and devote his time to something which promises remuneration. This is simple, ordinary sense, and any man may be supposed to be capable of appreciating the argument. He could also, at nominal cost, encourage the growth of forest trees upon them. There are thousands of acres in this Commonwealth which were once fields, but which are now covered with a growth of young, thrifty yellow pine. There is hardly any land

so poor that white poplar would not thrive upon it, and in a brief period producing a remunerative crop of pulp wood. Even Ailantus, which will grow almost anywhere, gives promise of coming value as a lumber for the cabinetmaker. The cost of these trees as a first growth is almost nothing. Meanwhile they would form shade and soil in which other, more desirable trees, would grow. The essential fact to bear in mind is that on land which yielded nothing, and was becoming poorer, fertility, under forest conditions, is increasing, a crop of some value is being raised, and almost no money or labor is expended. The gain, however small, is on the side of the farmer, or land owner. Furthermore, this gain promises, if the business is wisely conducted, to become greater each year, because of increasing scarcity of wood and increasing demand for it. It must be remembered that new uses are being discovered for wood faster than substitutes for it are found. But if such a plan is to succeed, fires and cattle must be kept off of the ground. Ultimately we shall, on just such land, come to plant chestnut, locust, various oaks and white pine. Indeed, once the first growth or protective cover is formed, a day in autumn devoted to dropping acorns, chestnuts and locust seed, in shallow holes, and then giving them a slight covering of earth and leaves, would more than likely show results which would surprise the planter. These, however, are details which cannot be considered in this connection.

To meet just this condition of affairs the State has wisely enacted the following law:

AN ACT

For the encouragement of forest culture, and providing penalties for the injury and destruction of forests.

Section 1. Be it enacted, etc., That in consideration of the public benefit to be derived from the planting and cultivation of forest or timber trees, the owner or owners of any land in this Commonwealth planted with forest or timber trees in number not less than twelve hundred to the acre, shall, on making due proof thereof, be entitled to receive annually from the commissioners of their respective counties, during the period that the said trees are maintained in sound condition upon the said land, the following sums of money:

For a period of ten years after the land has been so planted a sum equal to ninety per centum of all the taxes annually assessed and paid upon the said land, or so much of the ninety per centum as shall not exceed the sum of forty-five cents per acre.

For a second period of ten years, a sum equal to eighty per centum of the said taxes, or so much of the eighty per centum as shall not exceed the sum of forty cents per acre.

For a third and final period of ten years, a sum equal to fifty

per centum of the said taxes, or so much of the said fifty per centum as shall not exceed the sum of twenty-five cents per acre.

Provided, That it shall be lawful for the owner or owners of the said land, after the same has been so planted for at least ten years, to thin out and reduce the number of trees growing thereon to not less than six hundred to the acre, so long as no portion of the said land shall be absolutely cleared of the said trees;

And provided also, That the benefits of this act shall not be extended to nurserymen or others growing trees for sale for future planting.

Section 2. The owner or owners of forest or timber land in this Commonwealth, which has been cleared of merchantable timber, who shall, within one year after the said land has been so cleared, have given notice to the commissioners of their respective counties that the said land is to be maintained in timber, and who shall maintain upon the said land young forest or timber trees in sound condition, in number at least twelve hundred to the acre, shall, on making due proof thereof be entitled to receive annually from the commissioners of their respective counties the sums of money mentioned in the first section of this act: Provided, That the first period of ten years shall be counted from the time that the said land has been cleared of merchantable timber, and, that after the said first period of ten years, the number of trees upon the said land may be reduced as in the first section is provided.

Section 3. Any person or persons who shall wilfully or carelessly cut bark from, or otherwise cut, burn or injure any tree, plant, shrub or sprout planted, growing or being on any land in this Commonwealth, without the consent of the owner or owners thereof first had, obtained, or who without such consent, shall kindle, or cause to be kindled, a fire on any forest or timber land in this Commonwealth, or who shall carry into or over any forest or timber land any lighted candle, lamp or torch, or other fire, without having the same secured in a lantern or other closed vessel, or who shall discharge or set off fireworks of any kind on said land or among the trees thereon, or who shall wilfully or carelessly burn or fire upon his or their own land, or that of others, any tree, brush, stubble or other combustible material whereby fire shall be communicated to the leaves, brush or timber upon any forest or timber lands belonging to other parties, shall be subject to a penalty not exceeding one hundred dollars for each offense committed, with costs of suit: Provided, That if the defendant or defendants neglect or refuse to pay at once the penalty imposed and costs, or shall not enter sufficient bail for the payment of the same within ten days, he or they shall be committed to the common jail of said county for a period of not less than one day for each dollar of the penalty imposed:

And provided, When the penalty imposed is above five dollars, the defendant or defendants may enter into a recognizance, with good security, to answer said complaint on a charge of misdemeanor, before the court of quarter sessions of the peace of the county in which the offense is committed, which court, on conviction of the defendant or defendants of the offense so charged and failure to pay the penalty imposed by this act, with costs, shall commit said defendant or defendants to the common jail of the county for a period of not less than one day for each dollar of penalty imposed.

Section 4. Any justice of the peace or alderman, upon information or complaint made before him by the affidavit of one or more persons of the violation of this act, by any person or persons shall issue his warrant to any constable or police officer to cause such person or persons to be arrested and brought before the said justice of the peace or alderman, who shall hear and determine the guilt or innocence of the person or persons so charged, who, if convicted of the said offense, shall be sentenced to pay the penalty aforesaid.

Section 5. The commissioners of each county shall, within one month after the passage of this act, cause the same to be published one or more times, in one newspaper of general circulation in their respective counties.

Pamphlet Laws, 1887, p. 287.

As this paper deals with the relations of the forest to the farmer, it would be out of place to introduce the wider bearings of State forest reservations. There are, however, most important connections existing between the State, the farmers and the forests, and it is proper that they should be more fully understood. For example, one may assume that so long as a forest stands on a portion of a farm it is doing a public service, because of its relations to the atmosphere and the rainfall. In fact it would usually be hard to show that the owner derived any more benefit from his standing timber than the citizens generally did. He, however, pays all the tax upon it. Indeed, during the financial stress of recent years, the owners have frequently been obliged to remove the trees in order to realize something from land upon which they were paying money out. This may seem incredible, but it can be proven. In other words, in self protection, the farmer was driven to remove forest growth, which, under existing circumstances, was actually of more value to the Commonwealth than the taxes paid upon it were. Clearly there must be something wrong with legislation which drives a man to impoverish the State! It should also be remembered at the same time that forest property is the most open to damage by intruders, and yet as a matter of fact, though taxes are paid upon it, the State practically accords it, now, no protection. The injustice of

this whole system of forest taxation (on farm land) is so plainly recognized by the farmers that repeated attempts have been made to remove it from the list of taxable property.

It is clear, however, that it would be unconstitutional to exempt it from taxation wholly. It is not named by the constitution among the privileged classes of property, and therefore must for the present remain subject to tax. That there may be no doubt upon this point, we quote Article IX, Sec. I, of the State Constitution:

"All taxes must be uniform, upon the same class of subjects, within the territorial limits of the authority levying the tax, and shall be levied and collected under general laws; but the General Assembly may, by general laws, exempt from taxation public property used for public purposes, actual places of religious worship, places of burial not used or held for private or corporate profit, and institutions of a purely public charity.

"Section 2. All laws exempting property from taxation, other than the property above enumerated, shall be void."

There is, however, a most hopeful alternative. That the power exists to classify property for the purposes of taxation is clear from the wording of Article IX, Sec. I, because the expression, "class of subjects," is used therein. That this power belongs to the General Assembly of the Commonwealth seems to be equally clear. See discussion of this subject by J. Carroll Hayes, attorney-at-law, Report of Department of Agriculture, 1895, Part II, p. 39, et seq.

Such classification in real estate is already made, "as seated lands and unseated lands." Paxson, J., in Wheeler vs. Philadelphia, 77 Pa. 349, writes: "Thus, timber lands, arable lands, mineral lands, urban and rural, may be divided into distinct classes, and subject to different rates."

It would appear to be possible to place farm timber lands in a distinct class and then, without wholly exempting them from taxes, subject them to a minimum rate. It should further be urged that this measure of relief is of vastly more importance to the State than it is to the land owners. It is merely a question whether it is more economical for the Commonwealth to grow and maintain that due proportion of timber land which science, observation and history have shown to be requisite for the continued prosperity of its citizens, or whether it cannot (in part at least,) be done to greater advantage by the land owners, if the State will make it possible for them to do so without pecuniary loss to themselves.

The fourth and last point remaining for discussion may be briefly disposed of, i. e.:

Can we afford to do without forests? It is a safe axiom of political economy that no State can afford to do without anything of value which it can produce almost without cost, on ground that is

capable of producing nothing else. It may furthermore be affirmed that the rule is no less applicable to the individual land owner than it is to the State. In other words, neither State nor individual can afford to allow resources to remain unutilized. This idea admits of a wide discussion; but we content ourselves with a mere statement of the principle.

The farmers of Pennsylvania, in common with other classes of citizens, may now witness the passing of two great industries which still are, or but recently were, largely developed within our limits, i. e., lumbering and tanning. Whatever diminishes their importance here will increase the cost of our lumbering and tanning products. It is furthermore worthy of remark that the producer can do, as he has done in the past, shift the scene of his operations and still conduct a profitable business; but the consumer located here must pay the additional cost of transportation. These industries give steady, remunerative employment to thousands of men who demand our farm products and whose wages pay for them.

In short the Pennsylvania farmer can no more afford to do without the forests which crown our high lands and mountain sides, and are a part of the farm areas, than he can afford to do without timber, without soil renewal, or without a constant, even supply of pure water.

If we remove, without restoring the forests on the otherwise unproductive lands of the Commonwealth, we cannot expect to escape the evil effects which always follow when the long-established order of nature has been suddenly violated.

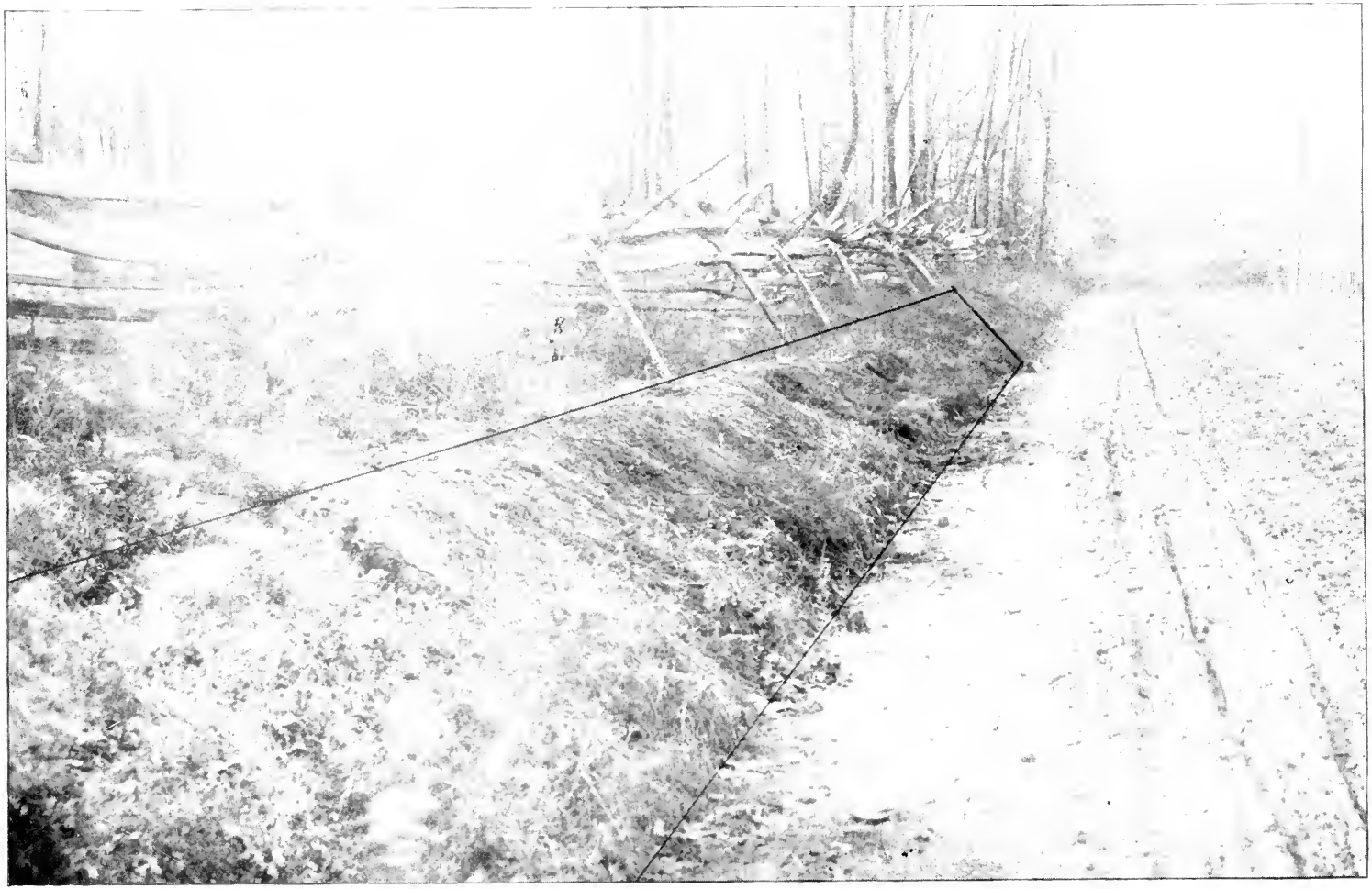
REMOVAL OF THE FERTILE SOIL FROM THE FARM BY WATER.

In a brief paper elsewhere in this volume the writer has stated in general terms the relations between forests and the soil of farms. This article is intended to present some more detailed and practical suggestions upon the same subject.

Just how valuable this soil is which is washed away from our cultivated acres will appear from the following statement made by a gentleman who was well-known in Pennsylvania and recognized as one of our most wide-awake farmers. The late Colonel James Young, of Middletown, was asked at a meeting of the State Board of Agriculture, what fertilizer he derived the largest returns from. He replied promptly, that in the winter he kept men employed cleaning out the bottom of the canal, which ran through his land, and that he thought this paid him better than any form of fertilizer he could use. In short, he said, that it was about the most profitable industry on his farm. Colonel Young was simply gathering up the wash from his own land and from that of others, further up stream, and restoring it all to his own land. It was a far-sighted, legitimate enterprise, one which was an example of the application of common sense to farming. It also converted his productive farms into object lessons for the rest of the community.

Just how great the volume of this fertile soil wash is very few persons have any idea of. Usually it goes on and attracts but little attention. Unless it in some way becomes conspicuous by its unusual amount, or by becoming a nuisance in the form of mud or dust in our roads.

The illustration accompanying this article is one, however, out of many which might have been had this summer. The space included within the dark lines shows the location of such a wash, and to a certain extent its volume. The history of that pile of fertility (indicated by the lines aforesaid), is this: Last summer, it was observed that the corn field above the road, having an average slope of probably three degrees, was badly washed after each heavy shower. The loss of soil was very apparent. The field was in corn, and of course its surface was loose. Over the whole surface, observation showed, there had been a general removal of material, which



SECTION OF ROAD SHOWING WASH FROM FIELD.

was the best, because it was the most *soluble, and therefore best adapted to the uses of the growing crop. This soil had also, in each depression, been worn out more deeply because the water had there gathered into small rivulets or streams, and its erosive power was greater along such lines. Finally, this soluble soil found its way out of the field and into the edge of the road, where it lay during most of the summer in a condition alternating between mud and dust. If the soil which had been washed away from that acre of good land, in a single season, had been placed on one of the many impoverished acres of the Commonwealth, it is probable that there would have been enough of it to have produced a fair crop. As it was, instead of being a source of benefit to the land owner, it had become more or less of a nuisance to the traveling community. In the autumn this material was gathered up (wisely enough) to be replaced upon the field whence it came. It is worthy of note that in the woods adjacent (visible in the illustration,) there is almost no sign of wash. The rain appears to have been either wholly absorbed, or its flow so held in check that it was incapable of doing any damage on woodland having that same degree of slope. Its damage upon the same field, if it had been in sod, would have been vastly less than it was on the plowed field, but it would, probably, have been considerably greater than in the woods.

Another instance of the effect of wash it may be worth while to give here. In traveling through a very beautiful valley in the central part of Pennsylvania, it was observed that portions had but recently been cleared of the trees. There were signs of abundant crops on the ground from which the stumps had not as yet wholly disappeared. On the other hand, where the land had been longer under cultivation the yield was scanty. The solution of this was easily reached when the wash from the field into the road was observed.

The question is sometimes asked why a ridge top, or a portion of a hillside near the top, remains fertile so much longer than the ground just at the foot of the hill. Instances, or alleged instances, have recently come to my notice. The fact is not hard to understand, though the same explanation will not always answer on the same spot. Time is an element of the problem. For example, when the land is first cleared, that portion which is highest, whether it be the top of a hillside or a level table-land, can receive no considerable volume of water from any higher point. On the table-land an immense proportion of the rainfall goes into the ground. The decomposing rocks below the surface renew fertility as fast as it is washed out on the surface. The same is true of the top of the hill-

*Not soluble in a chemical sense, but capable of being suspended in and carried by water.

side. Each foot, for example, carries but little more water than fell upon it. Neither rain nor melting snow have had time or chance to gather into a torrent with great eroding power. The land at the bottom may be in one of two conditions. Before it was cleared a small quantity of fertile soil, humus resulting in great part from decomposing leaves, had gradually been carried down the slope above and been arrested at that point. Hence, as a rule, the foot of the hill in a wooded condition is more fertile than the higher portions. This is clearly shown by the product being larger and more vigorous. This condition of affairs continues after the clearing has been made for a varying period of time, the length of which will depend upon the conditions. Sooner or later, however, the land at the foot of the hill becomes at least as unproductive as that above. The reason of this is obvious. The water which flows from the top of the hill flows with an ever-increasing velocity as it descends. It has but little force when it starts, but gathers strength and erosive power as it reaches the bottom. The result is inevitable. Not only is the soil which was accumulating while the wood remained on the ground removed, but beside this, the original natural surface goes with it. Surface impoverishment goes on more rapidly than soil formation does below, hence results a greater sterility on the lower grounds than those of the plateau, or of the hill top. Or to state the same idea as is more generally done, the top of the hill has become richer than the foot and the lower part of the side.

The present condition of a very large portion of the steeper regions of the State is already in a deplorable condition. The northern tier of counties is within the belt once covered by glaciers. Or perhaps it would be better to state that the signs of glacial action are most marked there. Such regions, as Prof. Shaler has well remarked, do not suffer severely from washing out of the elements of fertility, because "owing to the depth and loose aggregation" of the materials deposited by the ice masses, a large part of the water soaks into the ground. It is, therefore, quite as likely to increase the quantity of material fit for plant food as it is to remove it. When, however, we study the counties which make up the southern half of the Commonwealth, a different condition of affairs is at once visible. The traces of glacial action are less plain and signs of soil impoverishment are correspondingly more common. Even in such counties as Chester and York, which, on the whole, possess a vast agricultural wealth, there is probably a larger acreage of land so impoverished, that it cannot be counted upon for a crop, than there is in Susquehanna county. The unpleasant truth had better be stated that Pennsylvania possesses a vast acreage now under a nominal system of agriculture, which is falling lower each year in the scale of productiveness, which gives no promise of future agricul-

tural value, and which should, with the least possible delay, be restored to a forest condition. The steep, shaly ridges within our limits which have but little natural productiveness, which impose upon the unfortunate who attempts to farm them an extra labor and cost to maintain them in a remunerative condition, and even then very frequently fail to answer to even moderate expectations, are examples.

It may be well here to quote a general statement from the "Economic Aspects of Soil Erosion," by Professor N. S. Shaler, whose observations upon this point have been careful, long-continued, and have extended over wide areas. "Owing to the fact that in North America generally the rainfall is apt to have a torrential character (the precipitation taking place at a rate which is not common in Europe) and to the fact that these downpours are likely to occur on ground which has been loosened by the frost, our soils are exposed to a measure of danger much greater than that which menaces the fields of the Old World. There appears to be but one way by which we may meet this danger—this is by limiting the work of the plow to those fields which have a degree of slope so slight that with proper tillage they may not be exposed to scouring action. Although this classification has to be made for each district and species of soil, it may in general be said that no field which has a greater slope than five feet vertical in one hundred feet of length should in any country be exposed to the danger which ordinary cropping inflicts. Areas from this measure of inclination upward to thrice this rate of slope, or to a maximum of fifteen feet in the hundred, may reasonably be plowed in order to bring them into the state of grass lands, but should not be tilled more than is necessary to retain them in this state. All areas having a slope of more than fifteen feet in one hundred should by the rules which the conservator of the soils is disposed to lay down, be devoted to forests which afford the only crop that can be harvested from such ground without a swift and immediate loss of fertility."

There remains for consideration the other aspect of this problem; i. e., the effects of the wash upon the land where it may be arrested. If this soil so deposited is fertile the land receiving it is a gainer. If, on the other hand, as often happens, sand, stone and pebbles are deposited upon the lower land, the effect is most destructive. This latter condition seldom occurs except where deep gulches have been worn out of the hillside above, and where the water flow has assumed the character of a torrent. In this country land lost to cultivation by the overflow of sand and rocks is not large in area. Certainly not, at least as compared with certain districts in Europe. For example, we are reliably informed that the "French government and the farmers together have spent during the last thirty

years over $40,000,000, and expect to spend three or four times that amount to reforest 1,000,000 acres of denuded mountain sides, the soil and debris from which have been carried by the torrents of water into the plain covering over 8,000,000 acres of fertile ground and making it useless for agriculture." Still it is important enough here to merit our consideration.

How may the damage already done be repaired? This resolves itself mainly into filling up the gulches worn into the hillsides and bringing the areas overflowed by the deluge of debris into a fit condition of farming purposes. The latter part is simply to remove surface stones and add fertility enough to secure a crop. This, however, is subsequent to filling up the gulches, as if done before the wash was arrested, it would simply be labor lost. The important part of the problem then is to arrest the water flow in the gulches. Attack an enemy in his weakest point. In the case of water flow it is where it begins. In hilly regions, where such washes are most frequent and most damaging, there is usually an abundance of stones which may with advantage to the farm, be gathered and dumped into the upper end of the gully, thus lowering the point at which the wash begins, and to that extent lessening the destructive force of the flowing water. Every foot thus gained at the upper end renders the task easier.

There are, however, extensive gulches in which such direct, unaided repair would be an immense task. We must make the torrent itself expend its power in repairing the damages it has caused. In France and Germany this has developed almost into a science. The thing aimed at is: First, to check the velocity of the descending water, and second, to arrest permanently the soil which the water carries downward with it. All such soil (or stone) is thus deposited where it will do the best service. To accomplish these desirable objects the course of the ravine is partly filled at various points with brush, which is held in place, that it be not washed out, by weights such as stones, logs placed transversely to the course of the gulch and firmly fixed in position. It requires no explanation to understand how so simple a device as this may both retard the speed of the water and encourage deposition of the earthy matters which it carries. Furthermore, the water will flow in all ordinary times through the interstices. The undermining process in the sides of the deepest part of the gully are largely arrested. This allows chance to further bind the bank by a growth of willows or such species of shrubbery or trees as will grow most promptly in the location. When willow brush can be obtained in a living condition and so placed as to be in contact with a moist soil, they may be expected to grow, and as they ascend out of the depths of the ravine, to not only hold soil but to constantly rise above it, by growth.

On most farms there are found a greater or less quantity of old rails. These placed lengthwise in the ravines, and held in place by stones thrown over them, often answer a good purpose.

How to prevent soil washing. This is of infinitely more importance than how to repair damages. It is more than doubtful whether as a people we are in a proper frame of mind to profit by the experience of other nations. It is unfortunately true that we shall probably go through the most costly process of gathering our own knowledge.

There are several principles involved in presentation of soil washing. It would at first appear impossible that the hardest, most compact soils are those in which destructive, deep washing occurs. This, however, becomes clear when one remembers that on such surfaces the water flows on top, with but little to arrest its speed, and consequently with little to diminish its destructive power. On the other hand, if the soil be loose and porous, and especially if it contains much vegetable matter, it has a large capacity for absorbing water, which slowly percolates away beneath the surface. The underlying principle here, then, is to secure a porous soil, and all the better if that porosity is gained by the roots of living plants, which produce also a strong cohesion in the mass of earth.

When ground much given to washing is plowed for the purpose of cropping, straw is often placed in the furrows, to be covered at the next round of the plow. This is a simple, time-honored method of singular efficiency.

Underdraining by the removal of surplus water increases the capacity, in times of heavy rainfall, of the soil for absorbing and holding water. This again diminishes, or often almost wholly prevents, destructive surface wash. It is well known that soils which are well limed are less apt to wash than those which are not.

There are times when these methods of preventing soil washing are, alone, wholly ineffectual and must be abandoned or used in connection with other methods. Among which are:

(a) Furrows or barriers which run over the field, as nearly as possible, horizontally. This slackens the speed of the water, diminishing its erosive power on the one hand and allowing increased chance of absorption (of the water) on the other hand.

(b) The formation of terraces, whose sloping surfaces (at least) may be in a dense sod, and whose flat parts may be cultivated or not, as happens.

(c) Planting belts of trees in the horizontal direction along a hillside. This allows a chance for the formation of an absorbing layer of humus and of leaves, which will aid the roots in changing the surface flow to one of underground character.

(d) Most important of all—giving up to growth of trees all such soil as is likely to wash or to involve considerable expense in pre-

venting it. The successful application of this principle sometimes involves considerable skill and thought. The land to be forested may be in the condition least suited for such work. It may be poor, dry and sun-scorched. It may even be that no tree of value could at first be induced to grow on it. We may even be glad to secure a luxuriant growth of weeds as the first product at such a place. Nevertheless, all such places can be reforested, if one is careful first in the selection of his seed, and second in doing every step of his work thoroughly.

How shall we proceed? First of all, select an area no larger than you can properly prepare and care for. It is quite possible that if the seeds to be sowed were placed on the ground when the frost is coming out, that the alternate freezing and thawing of the surface would bring them into close contact with the soil, as is the case with clover seed, and that many of them would grow. This method, however, is but an apology for what should be done. The ground should be broken up, if possible. If it cannot be done with the ordinary plow then it should be done with the primitive shovel plow. A good subsequent harrowing will tend to even up the surface and to further reduce the clods. Bear in mind what we are now seeking is the first tree covering, something which will afford protection to such trees as we desire ultimately to plant for their useful properties. We must, therefore, be willing to sow what will grow. Locust is always a valuable timber. It flourishes on almost any kind of soil and is much less apt to be bothered by the borer when planted in clumps or in quantity, than when it stands as an isolated tree, or row of trees, by the roadside. The ill-odored Ailantus, while in small demand now, promises in the future to have a value as furnishing wood for the cabinet maker. It has the supreme merit of thriving under neglect and of growing on almost any soil. The Catalpa tree (either the Eastern or the Western form) grows vigorously on a certain class of soils. It is, however, not adapted to every location. If the soil is fertile and moist there is but little doubt of its success. If, on the other hand, it is sowed in a clay soil over a limestone rock, the chances are not in its favor. Still it is so easily obtained that it may be well to include it in the present list. The wood is valuable for fence posts.

These seeds may all be planted in early spring—the locust after having received a good preliminary soaking in hot water to soften the outer shell, and the Ailantus and the Catalpa after having been dampened over night to waken them up. The introduced white poplar has the habit of growing on almost any soil. Moreover, when once started, its tendency to self multiplication is wonderful. This tree produces its seed in early spring, and even if not in time to plant with the seed, already indicated, would have a fair chance of success

in at least a moderate degree if sown broadcast on the ground subsequently. Its seeds are light, and provided with a silky down which enables the wind to carry them to great distances. It is suggested that mixing these over night with damp sand and sowing the whole (sand and seeds) together broadcast, would obviate the danger of the seeds being carried off the ground by wind.

How shall they be sowed? That depends. First of all, in large quantity. Your immediate object is to secure shade and leaf litter and a penetration of the earth by the roots. These conditions having been acquired, the rest is easy. If sowed broadcast, as would be desirable on the soil we are now considering, a subsequent harrowing would cover the seed and increase its chances.

Such a plantation, once started, would require thinning out very soon, else it would develop into the thicket condition, which so far as prevention of surface wash was concerned, would be effectual enough, but it would not give the best promise of a crop of valuable timber. It should not be necessary to suggest that browsing animals should not be allowed access to such grounds. Their presence would be fatal to any successful forestry operations. Fire of course would be disastrous. The method just described is simply a slight improvement of the natural plan by which we so often see old, abandoned fields covered with a fresh forest growth. It has, however, this advantage that the growth is more likely to be prompt, dense and desirable. It is to be understood that the chief use of such a forest is to serve as a protection to more desirable trees, which may be introduced by methods already well understood.

There is another class of land, which, though no longer remunerative under ordinary agriculture, is still better than that we have just described, and which it may be desirable to cover as speedily as possible with a forest growth. The preparation of the soil here may be more thorough. And while the same broadcast methods of sowing may still be resorted to, it is by no means certain that they should be. Having some choice in the matter, it may be wise to secure a more orderly arrangement of the trees, not only because greater protection against wash is thus obtained, but because a better quality and a larger quantity of timber is secured. Indeed, it may be a question for the landowner to decide whether he will sow the whole surface by seed, or whether he will raise his seedlings in a nursery and then transplant them in the soil he desires to reforest. Such soil also admits of a larger list of seed which may be sown with fair promise of success: Elm, two or three species of ash and red maple may be added to the list already named for covering the ground speedily. And as the season's growth is more likely to be vigorous, the sowing may be longer delayed, or done, indeed, when the seeds ripen—from June to October. It may be suggested that in company with these

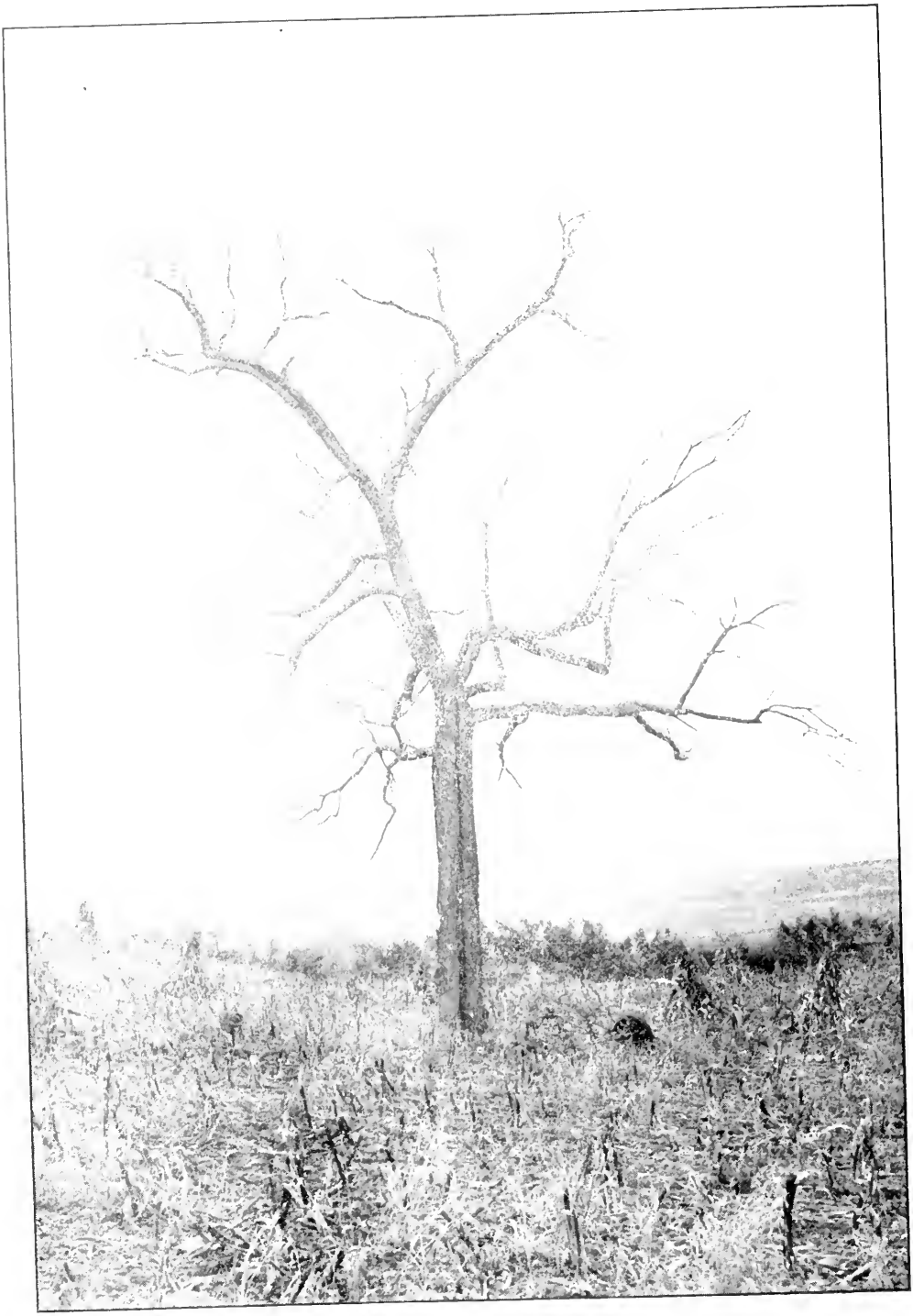
seeds there can also be a light sowing of such leguminous plants as will not only give protection to the tender trees, but will at the same time rapidly add nitrogen to the soil; i. e., field peas, and, certainly for the southern half of Pennsylvania, crimson clover. It should be stated that the locust tree is a nitrogen gatherer, and therefore adds to the fertility of the soil.

The other alternative to sowing is by placing the seeds in rows. This is probably on the whole better adapted to the weightier seeds—the nuts and acorns for example.

The methods to be employed for each kind of seed have been fully discussed in the report of this department for 1895. It will, therefore, be unnecessary to repeat them here.

If trees are raised in a nursery and transplanted the task is much less formidable than supposed. Three men, or two men and a boy, can plant by means of a "dibble" from three to four thousand such young trees in a day. The same instrument may be used in planting cuttings, or such seeds as require a considerable covering of earth.

To recapitulate, the two sovereign remedies against "wash" on a farm are, first, a dense, well-matted sward, which should be kept in good condition by frequent top dressing, or if this fails, a prompt restoration of land rendered unproductive to a forest condition.



WALNUT TREE

Producing Fruit Externally Resembling the Hickory Nut.

A WALNUT FREAK.

In the winter of 1895, my attention was called by Mr. William H. Groninger, clerk to the commissioners of Juniata county, to a remarkable fruit produced by a walnut tree near Pleasant View post-office, in the county above named. The statement made in connection with the tree was that it was a walnut tree which produced hickory nuts.

Mr. Groninger handed me the fruit for inspection. Naturally enough I was cautious about expressing an opinion concerning so remarkable a production as the one held in my hand. It was apparently a black walnut, which retained its outer hull, or husk, in a wrinkled or weathered condition. I noticed that its free or upper end showed signs of splitting into valves, after the manner of the ordinary hickory nut. The other end, on which the point of attachment to the branch was still visible, had the texture, color and odor of the walnut, and of that only. The nut itself was unmistakably a walnut.

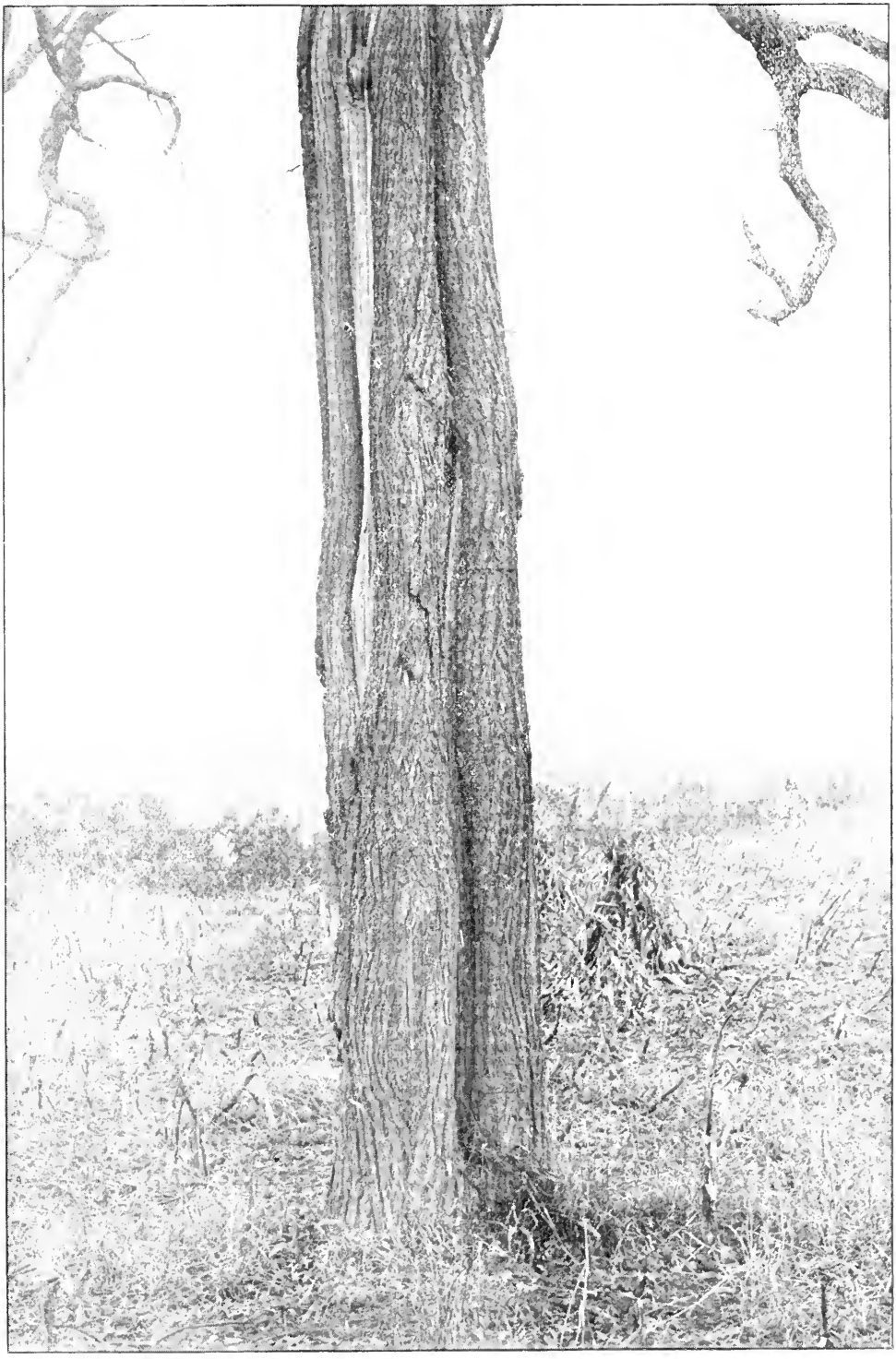
On April 16th, 1896, Mr. M. S. Esh was kind enough to take me to see the tree. It stands within a few minutes' walk of the railroad station known as Warble, on top of a low ridge, or hill, and within half a mile of the mountains on the southern side of the Tuscarora valley. The tree was about forty feet high. The trunk was two feet seven inches in diameter at four feet from the ground. The illustration will show that it had in earlier days received severe injury. On the one side, toward the west, was a scar much more than a foot wide above, tapering down several feet to a point. It seemed as though one of the largest limbs had been torn off there by a storm. On the side toward the south, apparently an earlier and more extensive injury had overtaken the tree. The illustration will show that it extends in one limb from above where the primary branches arise to the ground, and that it involves the entire heart of the trunk. The general belief is in the neighborhood that it is the result of a stroke of lightning. This I am not inclined to doubt. The tree is old and seems to grow but little. The statement of Mr. W. D. Beale, a middle-aged man, who grew up (I am informed) on the farm, was that the tree seemed to have changed but little in appearance or size as long as he can remember it. At the time of my visit (April,

1895) the ground was abundantly strewn with the weathered fruit of the previous season. This fruit was probably half of the usual normal character, and presented no apparent difference from the ordinary black walnut, either in its outer husk, or in the nut and kernel. The other half of the fruit which lay on the ground presented in a more or less marked degree on its outer husk the split character of the hickory nut. The valves sometimes were barely indicated at the tip. At others they were clearly marked to the middle of the fruit or even lower still, but never quite to the base. The nut itself in every instance was a genuine walnut.

On leaving this freak my first thought was that it must be a hybrid. This, however, cannot be the case, because the tree bears fruit of no constant character. Part is normal and the remainder is of the character indicated. There remains now to be stated that, which to my mind, is the most singular fact of all in connection with the history of the tree; i. e., its fruit not only varies on the tree in the same year, but one year's product appears to be no certain sign of the character of the fruit on the following year. For example, the fruit of 1895 was, as has been stated, about evenly divided between the normal character and the sport. The fruit of the season of 1896 was almost, if not quite, wholly normal. At least I failed to find any pronounced instances of the sport in the fruit when I visited the tree in October of this year. There was at the time an abundant crop of fruit lying on the ground, and the only indication I was able to observe of any departure from the normal state were two fruits which bore faint longitudinal ridges toward their apex.

So far as I am aware, no demonstrable solution of this singular biological problem is to be had. Still there are certain facts which point to a possible explanation.

It is clear that a tree so maimed as this one cannot be regarded as in a healthy condition. Leaving out of sight the fact that it is practically a mere shell, there remains also the still more important fact that one-half of that shell is destroyed, and that if the limbs above receive full nourishment it must be through a much diminished surface of cambium and young wood. That nutrition is seriously impaired might probably be inferred from the remark of Mr. Beale, that he has known the tree all his life, and that it has changed but little, if any, during that time. Its growth is, therefore, exceedingly slow. There is another fact to be considered as pointing toward though not proving the explanation about to be offered; i. e., the season of 1895 was one of phenomenal drought, and the abnormal fruit formed about fifty per cent. of the yield of that season. The summer of 1896 was more favorable, and there was but little shortage in the rainfall. During this season the fruit was practically wholly normal. May it not be a case of arrested development due to impaired nutrition?



TRUNK OF WALNUT TREE
Which Produces Fruit Externally Resembling the Hickory Nut.

WALNUT HUSK.
Dividing like that of the Hickory Nut.

If this is true, it would probably also lead to the conclusion that the typical black walnut (Juglans nigra) is biologically higher than any of the species of hickory (Carya) and that the former may be considered as a development from the latter.

An effort was made to ascertain when the tree was injured and whether any connection could be traced between the injury and the appearance of the abnormal fruit. No information of positive character upon that point seems to be obtainable.

The leaves do not seem to differ in any essential from those ordinarily found on the walnut tree.

PARTIAL ABSTRACT STATEMENT OF TIMBER CUT DURING THE YEAR 1896 IN PENNSYLVANIA.

To Hon. Thos. J. Edge, Secretary of Agriculture:

Dear Sir: It is by law made the duty of the Secretary of Agriculture, "as far as practicable, to procure statistics of the amount of timber cut during each year, the purposes for which it is used and the amount of land thus cleared as compared with the amount of land newly brought under timber cultivation."

I have, under your direction, instituted such inquiries as were possible, to comply with the above requirement.

About fourteen hundred circulars were sent out to the lumbermen of the State. Replies have been received from about half of them. It is unfortunate that some of the largest operators are conspicuous by absence of statistics from this report. We can only say that these figures represent in brief the information which we have received up to December 1st, 1896, and that a very large proportion of the timber cut remains unreported to us. This is the more worthy of regret, because it prevents such a showing to the public as would without injury to anyone, probably hasten legal relief and protection in which the lumbermen themselves have the largest financial interest.

The brief period elapsing between the close of the year and the appearance of your report makes it impossible to secure all the information desired. It is therefore suggested that our reports hereafter be considered as extending from June 1st of one year to the same date of the following year.

It is proper that I should add, I am indebted to Mr. Robert S. Conklin, clerk of the Forestry Division, for collection and preparation of the statistics used in the following table. It has been no slight task, and his zeal and fidelity are worthy of commendation.

There still remains a large body of information in our hands upon this subject which would be well worth publishing later in some popular form.

It is with regret that we announce there is as yet, so far as we are informed, no determined, practical, intelligent effort at timber restoration on a large scale in this State, except by the directors of the Philadelphia Trusts, who have instituted a measure of rational

forestry on the lands in their care located in Schuylkill and Centre counties.

There are some other examples of careful forest protection, in the face of great danger, from forest fires. As a conspicuous instance we may point to the land owned and managed by General Paul Oliver, in Luzerne county.

It is in vain to expect any extensive tree planting or true forestry until the State will offer the owner some real protection against forest fires, or, in other words, until it is made by law as heinous an offense to fire a forest as it is to fire a barn.

I am, sir, with great respect,

J. T. ROTHROCK,

Commissioner of Forestry.

PARTIAL SUMMARY OF TIMBER CUT, BY COUNTIES.

County	Acres cut over.	Kinds of Timber Cut, in Feet, Board Measure. Pine.	Hemlock.	Other woods.	Bark peeled, cords.
Allegheny,	606	.....	.....	883,000	.....
Armstrong,	525	244,000	650,000	1,740,000	547
Beaver,	159	.....	.....	140,000	.....
Bedford,	684	175,200	12,000	1,102,300	330
Berks,	231	.....	.....	831,000	312
Blair,	1,180	80,000	627,000	1,225,000	14
Bradford,	1,470	720,000	7,027,000	1,765,000	2,618
Bucks,	219	.....	.....	1,495,000	165
Butler,	289	.....	.....	1,025,000	.....
Cambria,	3,925	100,000	16,345,000	2,070,000	6,150
Cameron,	2,558	150,000	27,317,844	100,000	15,760
Carbon,	65	80,000	33[illegible]00	340,000	75
Centre,	5,093	11,736,000	3 2[illegible]0,000	3 394,000	8,575
Chester,	104	.....	.....	1,[illegible]24,000	200
Clarion,	1,639	11,055,000	3,504,000	1,958,000	912
Clearfield,	14,585	10,974,000	94,000,00	8,[illegible]66,000	34,513
Clinton,	2,734	6,978,000	6,285,000	4,466,000	5,825
Columbia,	350	885,287	170,000	340,000	480
Crawford,	519	10,000	2,[illegible]35,000	4,289,000	935
Cumberland,	196	50,000	.....	900,000	250
Dauphin,	270	200,000	....	3,468,000	213
Delaware,	.....	.....	.....	33,000	.....
Elk,	24,768	2,835,000	310,560,842	4,290,000	168,402
Erie,	285	.....	1,510,000	1,702,000	264
Fayette,	2,518	.....	.....	14,040,000	325
Forest,	10,092	12,668,270	119,491,654	3,453,[illegible]14	66,246
Franklin,	867	702,000	.....	1,880,000	720
Fulton,	660	440,000	.....	110,000	.....
Greene,	15	.....	.....	52,000	.....
Huntingdon,	1,055	525,000	.....	901,000	264
Indiana,	1,042	5,206,822	10,794,000	7,056,724	8,530
Jefferson,	7,105	17,822,000	68,425,000	3,465,000	26,600
Juniata,	680	200,000	440,000	675,000	330
Lackawanna,	155	60,000	730,000	660,000	270
Lancaster,	2	.....	.....	120,000	.....
Lawrence,	242	.....	.....	2,134,000	.....
Lebanon,	200	1,000,000	1,800,000	100,000	40
Lehigh,	102	.....	.....	935,000	245
Luzerne,	840	800,000	498,000	817,000	462
Lycoming,	8,185	3,005,000	24,880,000	2,009,000	14,351
McKean,	5,240	.....	40,200,000	7,470,000	23,798
Mercer,	316	.....	.....	3,164,511	.....
Mifflin,	1,765	395,000	300,000	1,750,000	1,190
Montgomery,	90	.....	.....	750,000	.....
Monroe,	200	1,000,000	.....	2,180,000	100
Montour,	100	50,000	.....	150,000	50
Northampton,	70	.....	.....	150,000	100
Northumberland,	81	11,200	200,000	215,100	120
Perry,	1,747	440,000	120,000	1,907,000	957
Pike,	11,110	700,000	55,000	1,414,000	130
Potter,	6,204	1,225,000	220,805,000	4,485,000	36,649
Schuylkill,	250	670,000	1,300,000	630,000	385
Snyder,	2,147	5,970,000	12,000	978,000	3,083
Somerset,	4,249	974,500	2,550,000	15,620,000	3,343
Sullivan,	3,120	284,000	45,381,500	3,866,000	19,259
Susquehanna,	675	100,000	4,365,000	745,000	1,950
Tioga,	3,857	505,000	26,621,000	1,110,000	17,831
Union,	1,000	2,925,000	230,000	1,402,000	365
Venango,	360	300,000	1,100,000	1,060,000	455
Warren,	3,100	8,820,000	18,039,000	7,970,000	6,647
Washington,	110	.....	.....	1,124,000	.....
Wayne,	686	260,000	985,000	4,290,000	606
Westmoreland,	2,387	.....	200,000	2,513,000	500
Wyoming,	849	1,020,000	3,708,500	2,900,000	3,143
York,	155	20,000	.....	920,000	130
Totals,	140,150	113,921,279	1,062,762,280	153,742,349	486,289

CHESTNUT POSSIBILITIES IN PENNSYLVANIA.

In the year 1803 Malthus published a work which inculcated the idea that it was necessary a considerable portion of mankind should die prematurely in order to keep the human population within the limits which the earth could sustain. It may be true that in the distant future such a doleful condition will be regarded as the natural and necessary one, but it is in the very distant future. The fact is, we are barely on the edge of our agricultural possibilities. By far the largest yields of the earth in the way of food supply await increasing knowledge and necessity.

To illustrate—it is fair to estimate that there are upon this globe not far from one hundred and fifty thousand species of flowering plants. On the one hand, the human family uses for food out of this vast host not over four hundred kinds. On the other hand, we know that but a small proportion of the remainder contains any poisonous or noxious properties.

It is fortunate that upon so important a question we are not left to conjecture. There are positive facts we can draw upon to support the statement that we are only on the edge of our possible food resources. For example, the island of Jamaica is probably no exception to the majority of tropical islands in its fertility. It would, if reduced to a square, be only about seventy miles each way. Yet, after feeding its own population, it sends into the markets of the world about nine million dollars' worth of fruit annually. A speedy and regular ocean service has made this fruit so common and so cheap in this country that we are fast coming to regard it as food rather than as a luxury. Now, with all the capacity for food production in that island, we must remember that of all the food products which Jamaica to-day exports, the great bulk comes from plants which are not native to the island, but are introduced there. Its native flora furnished the greater part of the means of support to the large aboriginal population prior to the period of discovery, but is almost wholly unutilized now. I might say it is forgotten. It awaits rediscovery.

Again, it is a fact which history will confirm that civilized man, so far as he has derived his food from the land, has done so almost entirely from the more fertile areas—at least deserts, with rare exception, do not, or have not, supported a dense population. It must, however, be remembered that there are plants with wholesome, abundant farinaceous seeds which are especially adapted to thrive on

just such abandoned areas. The family of plants to which the weed known as "lamb's quarters" belongs is of this character and some of the seed products have been utilized by the Indians from "time out of mind." We have, furthermore, every reason to think that those plants are capable of as much and as speedy improvement in quantity and in quality of fruit as any of our other grains.

There is a most important practical application of these statements. With these facts before us, with the real food-producing power of a host of plants, native and foreign, absolutely unknown, what right have we to confine ourselves to a few standard grains, and then failing to derive the old time revenues from them, give up with the despairing cry that "farming don't pay?" There are many things, once done at a profit, that don't pay now. The successful man in such an emergency seeks for something in his line of work that will pay. If a farmer, he looks about him for a new crop. It is to this point that we have been leading.

A walk through our cities during the autumn and early winter will show that large quantities of chestnuts are roasted and sold on the important corners. It will be observed that all of these, or nearly all, are of the large kinds which we collectively call Spanish chestnuts. It is impossible to give an exact estimate as to the quantity which are so sold. The suggestive fact is that most of them are imported. Is there any reason why they should be? Rather, is there not every reason why they should not be? Already a well-established market exists for more than we produce. There is every reason to think that the demand for fine chestnuts would increase as it has for fine grapes, fine oranges and fine mushrooms. It is the invariable law that increase in demand comes with improvement in quality. The mere fact that prices fall to such an extent that what at first is considered as a luxury becomes later to be regarded as a food, enlarges and steadies the demand and usually removes the product from an extravagant to a business basis.

These remarks are suggested by a recent visit to the "chestnut orchard" of Mr. Henry M. Engle. The hillside, which, from across the Susquehanna, fronts the town of Marietta, is the scene of his operations. It will probably be admitted by those who notice the place from a distance that any ordinary agricultural operations there are out of the question. It certainly will be allowed by those who climb the rocky slope that its only natural production is the growth of timber. Mr. Engle found it covered with a growth of thrifty chestnut trees. These he cut down and allowed sprouts to arise from the stump. When the sprouts were a year old, into the best of them, he placed grafts from the Paragon chestnut. His object being to graft a whole head of the sprout at one time. Of course this implied as a subsequent operation keeping down all lateral

branches below the graft, which was usually inserted at about two to four feet from the ground. Mr. Engle has, I believe, employed both whip and cleft grafting, but prefers the former. His methods involve no departure from rules well known and long practiced, except perhaps a little more care. The percentage of successful grafts will probably be somewhat smaller than on the ordinary fruit trees.

The rapidity of growth of a graft on a sprout from a well established root is simply amazing. Fuller, in "The Nut Culturist," page 79, speaks of such a graft (under his observation) which made during the first season a length of sixty-five feet when the main stem and the lateral branches were counted. It all came from a single bud.

A diameter of four inches is no unusual thickness for a paragon graft of as many years, on a thrifty sprout. In that time it may be expected to be in good bearing. Professor Heiges reports that when he visited the chestnut orchard of Mr. Engle, "trees grafted two years had as high as 35 buds, averaging three chestnuts per bur. Trees grafted four years had upward of 500 burs, by actual count." It is to be remembered that this was on ground capable of producing no other crop. This seems to be the proper place to say that when the chestnut timber has been cut and the sprouts started which are to produce such a crop of nuts, that if notice be given to the county commissioners within one year of the date of clearing of an intention to reforest the land, that the owner is entitled to a small State bounty for each acre, by act of June 1st, 1887. (See Pamphlet Laws, page 287; see also Report of Department of Agriculture, Part II, 1895, Forestry, page 28.)

The price of such nuts as the Paragon chestnut will of course vary for each season. This year, in November, the writer paid for half a bushel at the rate of seven and one-half dollars a bushel.

It may be fairly doubted whether it is best to attempt growing chestnuts for market on this plan—that is on the forestry basis. Will one not obtain a larger yield of large, sound fruit if the trees be isolated (or at least not in close clumps) and the ground beneath them kept clear of leaves and underbrush? This inquiry is suggested by the fact that such trees are less infested by fruit-destroying insects than those in forests, and furthermore, that where the ground can be kept clean and clear of underbrush, one has a better chance of destroying a large percentage of worms which would become the insect parents of the following year's worms.

Whether or not we could hope for an effectual protection against these pests if all diseased chestnuts were promptly collected and burned is yet a question; but there can be no doubt that such systematic destruction of the infested fruit would speedily decrease the quantity of fruit injured. There are early and late broods of chest-

nut worms. It would probably be wise to gather the fruit as soon as possible after it is ripe and keep it in a damp, cool place, whence all worms and diseased fruit could be removed and promptly destroyed.

It is unfortunate that as described above, land otherwise worthless, can be made to produce a valuable crop of chestnuts after we have realized one profit on the timber. It would, however, be very unfortunate if it were supposed that such land only should be used for chestnut culture. The fact is that it might be made even more profitable to raise chestnut trees from the seed and graft them with the variety we desire to raise, and allow these trees to stand where they had room to spread and where they could be under our immediate care. The yield of some such mature trees is fabulous. I have in mind one tree, about seventy years old, still in its prime, with many years apparently ahead of it, which in one season bore thirty-six dollars' worth of fruit, besides what was used by the family of the owner.

The relative hardiness of the Paragon stock as compared with the native wild chestnut may yet be probably regarded as not wholly settled. It seems necessary to repeat most positively the well known truth that no one should plant Paragon or other large variety under the impression that the resultant trees will produce fruit of a like size. If such happens it will be unusual. Grafting is the only method of certainly securing the special quality of fruit desired. Though it is to be remembered that even failure to raise trees which will produce fruit like that from which the trees came may occasionally, rarely indeed, produce an even better fruit. Hence trees grown (ungrafted) from the nut should be carefully studied. They may become the parents of valuable varieties. On the whole, it might be considered a promising venture for one to plant our native chestnuts where you desire them to stand, on cleared but waste land, and subsequently graft them with such a variety as the Ridgely or the Paragon. The Scott chestnut is said to have great merit. Among its good points it is claimed to be early bearing and to have a remarkable freedom from insect attacks.

There is one point especially worthy of mention; i. e., that occasionally a variety with new and sterling qualities springs from our common wild chestnut. There are some such instances which are well known, for example, where the fruit was of exceptionally large size and matured very early. Such a combination of qualities would be sure to find a sale, especially if added to them were the characteristic of hardiness.

How to keep chestnuts safely over winter for spring planting is by no means so easy as some would have us believe. It requires judgment, and I had almost said skill, even when it is remembered that when the essential conditions of success are to keep the nuts

from moulding in the autumn or early winter, to keep them damp, but not wet, and to keep them cold, avoiding sudden changes of temperature as much as possible. Mr. Fuller gives in his book on nut culture very exact directions. Take only sound nuts. Provide a box with a bottom pierced with small holes, which are to be covered with a bit of pottery. Put a layer of chestnuts on a layer of "moist, sharp sand" which is an inch deep. Then another layer of sand, and on top of this another layer of chestnuts, and so on. Then cover with sand two inches deep to allow for settling. Cover box with wire netting or strips of board to keep the mice out. Bury the box in some well-drained place in the ground, covering it with a foot of leaves. Some friends of mine scrape away leaves from under a tree, place the nuts on top of the ground and cover them with leaves and leave them until spring.

I am of the opinion, however, that if one wants to plant but a hundred or two chestnuts that he will have no cause to regret it if he prepares his bed in the autumn, makes a shallow furrow, places his chestnuts in it, covering them loosely with leaves an inch deep and then gives them a covering of half an inch of loose, rich soil. Making allowances for failures from animals, etc., I have about eighty per cent. of the nuts so planted to grow. Never allow a seed chestnut to become dry.

TWO WEEDS.

We seldom recognize a plant as a weed until it has become so common as to threaten some industry. In other words, it has already become a common nuisance before any war is commenced against it.

It may seem like a contradiction in terms, but it may fairly be stated that the proper time to fight a weed is before it becomes a weed.

Such a chance occurs now. From our Southern border a plant has invaded the State. Originally it came from Europe. It is exceedingly common in portions of Virginia, especially in the Shenandoah valley, and is there known as blue thistle, or occasionally is expressively named blue devils. To botanists it is known as Echium vulgare. The illustration accompanying is taken from life, and is a very satisfactory representation of the plant.

The blue thistle shows a marked preference for soils associated with limestone rocks, and of such soils it is not unlikely to take complete possession, unless they are frequently under cultivation.

It is true that up to this time it has not become a serious nuisance in this State. It is equally true that it will probably become such unless its increase is promptly prevented. Thus far it does not appear to have advanced more than seventy-five miles north of our southern border, and possibly its further advance will be slow, because it must adapt itself to the more rigorous conditions of a Northern climate. Under any view of the case, now is the time to extirpate the plant, before each of the thousands of seeds becomes the parent of another thousand.

The plant is biennial; that is, its principal function during the first season is to produce a strong root, well stored with nourishing matter. From this root a vigorous flowering and fruiting stem will be developed during the second summer.

The remedies are, frequent plowing and thick seeding, if the plant has already obtained a considerable hold on the farm. Or if it is just making an appearance, it may be headed off early in the second season by cutting the stem from the roots by a spud or pick-axe inserted just below the surface of the ground. It would doubtless also be possible to destroy it by repeated cutting or pulling, if these were commenced before the plant blossomed.

BLUE THISTLE.
Echium Vulgare.

The blue thistle may be briefly described thus: Herb, one to two feet high, one or more stalks from same root; rough, bristly-hairy; leaves narrowly lance-shaped, without footstalks; flowers, blue at first, then more or less pink, funnel-shaped, with a somewhat irregular, lobed margin, from half to three-quarters of an inch long, somewhat crowded on branches which are often coiled at the tip; four small roughened seeds in the bottom of the flower; blooms from June to September, or even later.

The second weed to which attention is called is popularly known in Pennsylvania as yellow daisy, brown betty, wild sun-flower. Botanically it is called Rudbeckia hirta. This plant is said to have been brought from the Mississippi valley to the East in clover seed. It also grows naturally in Western New York, and hence may be said to prefer a climate somewhat cooler than that of this State. Its increase here has been so slow and its advance so insidious that our farmers apparently have failed to recognize its dangerous character. But it is each year becoming better adapted to our conditions of soil and climate, and as it matures a large number of seeds, it is merely a question of time before its presence will be severely felt.

Of all the weeds which of recent years have invaded our State, this is the one for whose continued existence there is the least excuse. It is so conspicuous that it compels notice, and its multiplication has been thus far so slow that there can be no reason for allowing it to become a source of trouble. Yet its real character and power for harm are evident when it is noted that in the states north and east of us it is so abundant, just before the season of hay making, that it literally colors whole fields of grass yellow.

I do not remember to have seen a field of grass in this State from which it could not have been readily removed by pulling or digging. Its eradication seems to be a question of now or never. I make this statement in view of the fact that it continues to increase, and that it has already become a nuisance in Ohio and New York.

It may be described thus: Biennial herb, one to two and a-half feet high, rough-hairy, leaves narrowly oblong, without footstalks, lower ones more or less distinctly three-ribbed; flowers from an inch and a-half to four inches across, yellow, with a dark brown, convex or conical centre. (Like a small sun-flower and having its circumference composed of about fourteen yellow leaves.) If cut too early in the season it is likely to grow again and still produce a crop of flowers and seeds. It is becoming very popular with flower gatherers, who should by all means be encouraged to pull it. It blooms from June to August.

LOSSES BY FIRES IN PENNSYLVANIA IN THE YEAR 1896, SO FAR AS HEARD FROM.

By the burning of the Capitol building on February 2d, the mass of material which we had collected, at no little expense and labor, bearing upon forest fires, as well as upon the quantity and kinds of timber cut during the year 1896, were destroyed. But a few hours before the fire Mr. Conklin and I had completed our estimates upon data at hand. These lay on my table and were rescued. I make the following very brief statement:

Number of acres burned over in 1896,.....	178,982
Quantity of timber burned, feet board measure,.....	121,752,322
Quantity of manufactured lumber burned, feet board measure,.....	7,391,080
Cords of bark burned,.....	30,764
Cost of suppressing forest fires,.....	$21,269 00
Total money value of actual property burned,.....	$557,056 00

I desire to add that these figures are clearly below the actual facts; because: First. There was on the part of those who answered our inquiries a very remarkable absence of anything which looked like exaggeration. Second. Many of those furnishing information made no estimate of the value of the time spent by themselves and their neighbors in extinguishing fires. Third. In many instances there was no estimate of the money lost by burning of young timber. Fourth—Because from many regions in which it is known there were serious fires we were unable to obtain any replies to our inquiries. This is the more a matter of regret because the information sought was wholly in the interest of the sufferers.

In the above estimate we have not included the destruction of leaf mould and actual soil. These, as a matter of fact, exceed in value the timber destroyed, because its restoration is exceedingly slow, and without it reproduction of valuable timber often becomes very slow and in some instances impossible.

The state forests of New York, under fire warden protection, had burned over in 1895 (a much drier season than 1896) one acre out of 3474, whereas Pennsylvania in 1896, without fire wardens, had in its woodland areas one acre out of 51 burned over.

The second annual report of the Commissioners of Fisheries, Game

and Forests (1896) for New York (page 67) is very explicit, and declares that "ten years' experience in the matter has demonstrated that the present law relating to the protection of our woodlands from fire is a practical one. We have reason to believe that the widespread and disastrous fires which threatened the existence of our forests at one time will not recur. We expect that small burnings on private lands will continue to occur, and so there remains the difficult task of regulating the use of fire by land owners on their own property. In this work we are assisted by public sentiment in the forest towns, due to the law which provides that each town must pay half the expense of fighting and extinguishing woodland fires. There has, accordingly, arisen in each town a sort of censorship on the part of the citizens and taxpayers which acts as a deterrent in the careless use of fire by the thoughtless and ignorant members of the community."

It may help to the comprehension of this State's actual loss by fire if I were to add that the area burned over in 1896 was equal to a strip of land one mile wide and 280 miles long, and that it would require a wagon train of 112 miles in length to haul the bark so destroyed. If the bark were ranked up four feet wide and four feet high it would form a line almost 47 miles long.

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